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The Commonwealth of Massachusetts

REPORT OF THE SPECIAL COMMISSION RELATIVE TO DETERMINING THE ADEQUACY OF WATER SUPPLY IN THE COMMONWEALTH

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THE COMMONWEALTH OF MASSACHUSETTS

REPORT OF
THE SPECIAL COMMISSION
RELATIVE TO DETERMINING THE
ADEQUACY OF WATER SUPPLY
IN THE COMMONWEALTH

(under Chapter 13 of
the Resolves of 1977)

December 1978

The Commonwealth of Massachusetts

SPECIAL LEGISLATIVE COMMISSION ON WATER SUPPLY

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Senate Chairman
CAROL C. AMICK

House Chairman
JOHN F. CUSACK

Research Director
DEAN R. JOHNSON

Letter of Transmittal

To the Honorable House of Representatives and the Senate:

We, the undersigned having voted in the affirmative, do hereby transmit this report on the results of the investigation and study authorized under the provisions of Chapter 13 of the Resolves of 1977 on the Adequacy of Water Supply in the Commonwealth of Massachusetts.

Respectively Submitted:

Carol C. Amick
Senate Chairman

John F. Cusack
House Chairman

John W. Olver

Andrew P. Rogers, Jr.

William L. Saltonstall

Raymond A. Jordan, Jr.

Evelyn F. Murphy

Michael W. Morrissey

David W. Stickel

Peter L. McDowell

George J. O'Brien

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CHAPTER 13 of the Acts and Resolves of 1977

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-SEVEN

RESOLVE

PROVIDING FOR AN INVESTIGATION AND STUDY BY A SPECIAL COMMISSION RELATIVE TO DETERMINING THE ADEQUACY OF THE WATER SUPPLY IN THE COMMONWEALTH

Resolved, That a special commission, to consist of three members of the senate, five members of the house of representatives, and three persons to be appointed by the governor, is hereby established for the purpose of making an investigation and study relative to the proper and necessary functions of the commonwealth in the planning and implementation of a continuing water supply program to meet the current and future water-related needs of the commonwealth and to make such investigations, studies and recommendations relative to the most urgent statewide water supply priority issues with the intention of establishing a definitive water supply policy. Said commission is aldo directed to assess and to make recommendations relative to the identification of water supply needs throughout the commonwealth, and the means for meeting these identified needs. Said commission shall file its final report with the clerk of the house of representatives on or before the last Wednesday in December, nineteen hundred and seventy-eight.

Approved September 12, 1977.

NOTE.—Use ONE side of paper ONLY. Insert additional leaves, if necessary. Dates and numbers should be written in words.

MEMBERSHIP OF THE COMMISSION

Appointed by the President:

Sen. Carol C. Amick, Senate Chairman
Sen. John W. Olver
Sen. William L. Saltonstall

Appointed by the Speaker:

Rep. John F. Cusack, House Chairman
Rep. Andrew J. Rogers, Jr.
Rep. Raymond A. Jordan, Jr.
Rep. Michael W. Morrissey
Rep. Peter L. McDowell

Appointed by the Governor:

Evelyn F. Murphy
George J. O'Brien
David W. Stickel

SUMMARY OF THE COMMISSION'S RECOMMENDATIONS

Waste not, want not, is a maxim I would teach.
Let your watchword be dispatch, and practise what you preach;
Do not let your chances like sunbeams pass you by,
For you never miss the water till the well runs dry.

(Rowland Howard, 1876)

The development and implementation of a comprehensive, coordinated state-wide water resource management policy is a matter of urgent public concern. The availability of water for domestic consumption and industrial use, for recreation, for the maintenance of natural ecosystems, and for aesthetic enjoyment has historically been taken for granted in Massachusetts. There is a growing awareness, however, that water is a limited public resource which, if polluted, wasted and improperly managed, will fail to sustain present activities and jopordize hopes for future growth. An increasing number of communities face critical water supply shortages created by increased consumption, degradation of existing supplies, and lack of additional supplies.

The task of the Special Legislative Commission on the Adequacy of Water Supply in the Commonwealth has been to develop legislative recommendations for implementation of a systematic approach to water resources planning and management which recognizes the interrelated nature of the entire hydrologic system and addresses quantity and quality issues in an integrated manner. Development of such an

approach will take time, however. Considerations of cost, equity, economic development needs and citizen support must be weighed together will all of the state's other policies and priorities which might be affected.

The fourteen recommendations for legislative action contained in this report recognize the practical constraints on what can be accomplished in the immediate future. Accordingly, they address what the Commission finds to be the most pressing problems relative to continued adequacy of water supplies in the Commonwealth. The recommendations are organized into three categories: (1) those relating to improved management of the MDC water supply system; (2) those providing technical and financial assistance to communities; and (3) those improving state regulations and management capabilities relative to water resources.

MDC Water System

The Metropolitan District Commission regional water system serves 34 communities in the Metropolitan Water District and ten communities outside the district as far west as South Hadley and Chicopee. The current average consumption of 317 million gallons per day (mgd) exceeds the system's safe yield of 300 mgd. As consumption has grown over the years in the district and in surrounding communities, pressure to expand the system's membership and therefore its water supply has increased. The Commission has addressed this

problem of imbalance between supply and demand in the MDC system and the need to promote greater self-sufficiency with four recommendations.

To better regulate demand, the Commission recommends that no new communities be supplied with MDC water until average yearly consumption is below the safe yield of the system. To improve management of consumption within communities receiving MDC water, the Commission recommends the establishment of an Office of Water Conservation within the MDC, which would assist communities to implement comprehensive conservation programs and coordinate on-going conservation activities within the agency.

Addressing better supply management consistent with current state policy, which calls for development of local supplies before considering out-of-basin transfers, the Commission recommends revision of MDC enabling legislation to prohibit abandonment of local supplies. This measure also directs the MDC to investigate previously abandoned supplies and to evaluate the possibility of their reactivation for potable or industrial process use. The Commission's fourth recommendation further amends MDC enabling legislation to remove the existing prohibition against the development of additional local supplies by member communities.

These measures, coupled with the other recommendations which follow, will begin to bring the pressures on the MDC

water system under control so that the supply-demand imbalance can be corrected. Until that is accomplished, the provision of MDC water to other communities with legitimate needs cannot occur without potential environmental, political and economic conflicts.

Assistance to Communities

The Commission believes that a successful approach to water resource management must be based on management at the local community and basin level. Traditionally, water supply has been a local responsibility, and the Commission finds strong support for preserving this local control. However, many of the communities facing serious water system problems lack the proper tools, and often the financial capability, to solve their problems and will need assistance to develop successful solutions.

To assist communities facing critical water supply problems, the Commission makes four legislative recommendations. First, to provide technical assistance to communities for the development of water conservation programs, a state Office of Water Conservation is recommended. In addition to direct technical assistance functions, this office would engage in research on conservation techniques; provide leadership to encourage conservation among all types of water users; make recommendations for regulatory changes in other state agencies; and seek federal funds for water conservation programs.

Second, the Commission recommends a $10 million bond issue to fund a matching grant program for leak detection and distribution system rehabilitation. Antiquated pipes in the older municipalities are responsible for major losses of potable water which further strain inadequate supplies, loss of pressure for adequate fire protection, and degradation of water quality. The ultimate costs of repairing or replacing this vital part of the urban infrastructure are enormous, involving hundreds of millions of dollars over many years. The Commonwealth must continue its pressure on federal officials and the Congress to make funds available for this purpose. Massachusetts cannot afford to wait any longer, however, and must begin to address this serious problem by initiating its own rehabilitation program.

To assist communities to develop new supplies, the Commission recommends two measures. First, a ten-year program of detailed groundwater assessments and aquifer evaluations in cooperation with the U.S. Geological Survey is proposed. Funded on a fifty percent matching basis, the state share would be $2.5 million. Direct assistance to communities would, thus, be available to assure the wise and efficient development of the state's under-utilized groundwater resource. A second measure to assist hard-pressed communities calls for the extension of local debt limits for water supply projects, giving greater flexibility to communities in their financing of such projects.

State Regulations and Management Capability

The Commission makes six recommendations which are designed to improve state regulatory and planning functions. To assist in reducing consumption statewide, the current plumbing code is amended to require the installation of water saving fixtures in all new buildings and replacement installations. This simple change will save substantial amounts of water, reduce individual water bills, and lessen pressure on strained municipal water supplies; yet the fixtures are no more expensive than standard models.

The second and third recommendations address the need for the state to take a more comprehensive approach in protecting water supplies from contamination. First, the responsbilities of the Department of Environmental Quality Engineering to protect the Commonwealth's waters are expanded to specifically require regulation of all materials hazardous to water supplies. Present regulations covering such materials are to be reviewed and updated. Second, the duties of the Division of Water Pollution Control to regulate and protect against contamination of water are expanded to include groundwater and petroleum, so that the regulation of under ground gasoline storage will be included.

The final three recommendations deal with the pressing need to improve state water resource planning and coordination. First, the Water Resources Commission is given the

responsibility for drought contingency planning, an area now totally neglected by the state. A decade of above-average precipitation has supported continued growth in consumption, and the state's water supplies are more vulnerable than ever before to a drought. Advance planning must be initiated now to avoid serious dislocations when the next cycle of dry years occurs.

Second, the adoption of local water resource management plans pursuant to regulations recently promulgated by the Water Resources Commission is recommended for eligibility for state funding of water projects. These local plans will assist both the communities and the state in long-range decision making on all water resource issues. In addition, they will help to insure that the limited resources of the state are invested wisely and in the most cost-effective manner.

The final recommendation calls for the organziation of the various water planning functions now scattered among a variety of agencies and divisions into a new Division of Water Resources Planning and Technical Assistance. This restructuring will entail no new state expenditures but, in fact, will result in far greater effectiveness and responsiveness. Coordinated under the Water Resources Commission, this division will provide assistance to both local communities and to other state agencies which deal with water-related programs. It would also have responsibility for preparing

basin and statewide water resource management plans and for directing the various land and water data programs in a coordinated, integrated manner.

The recommendations summarized above represent the first step in the process of creating a rational, comprehensive water resource management program for the state. The Special Legislative Commission has identified a wide range of issues which remain to be addressed and has included in this report a recommended continuing resolution to guide its efforts. Major issues which will be investigated under this resolution include the development of mechanisms for the equitable allocation of both ground and surface water, and the revision of groundwater law to bring it into consistency with surface water law.

The finite character of Massachusetts' water resource, and the concomitant necessity to properly manage that asset, have at long last been recognized. The development of a sensible, effective management system which maximizes the benefits of this resource will necessitate changes in deeply ingrained attitudes and habits regarding the use of water and its provision. A continuing commitment of will and effort from all of the Commonwealth's institutions and citizens is required for success in this endeavor.

I. INTRODUCTION: ACTIVITIES OF THE COMMISSION

A. Background

Over the past several years, a dramatic shift has begun to occur in the public perception of the Commonwealth's water resource. Once regarded as an abundant and almost free good, water is now recognized as a finite resource requiring careful management by an increasing number of private citizens and public officials.

This shift in attitude is the result of several factors. The number of communities experiencing shortages due to growing demand has risen markedly in recent years. Many towns dependent on local supplies have had to institute seasonal water bans and regional systems, such as the MDC, have proposed diversions of water from other basins to augment their supplies. An increasing number of communities have also experienced diminished quality or even loss of local supplies due to contamination from bacteria, salt, landfills or chemicals. In addition, the cost of repairing or replacing existing water supply infrastructure, or providing additional capacity, has risen beyond the financial capacity of many towns and cities. Yet because annual precipitation in Massachusetts has been above average since the drought of the mid-sixties and supplies have been generally adequate to meet growing demands, many of the state's citizens were unaware of water supply issues until the Executive

Office of Environmental Affairs conducted a thorough review of state water policy.

The public and private water resource "community" in Massachusetts initiated a dialog in 1975 which focussed on the need to respond to the growing number of water supply problems before a statewide crisis occurred, such as the recurrence of a drought like that of the mid-sixties. Following a series of public seminars on water supply planning sponsored by EOEA and the University of Massachusetts Water Resources Research Center in Amherst, EOEA embarked on a comprehensive study of state water supply policy. Published as a draft Environmental Impact Report in January 1977, and as a final Environmental Impact Report in May 1978, the Massachusetts Water Supply Policy Statement (MWSP) explores the range of existing and developing water supply issues and recommends a series of policies, programs and actions to respond to those issues.

In June 1977, the Governor announced an effort led by Representative John Cusack of Arlington to establish a two-year legislative study commission to study water resource management and recommend legislation to implement the state's developing water supply policy. The Special Legislative Commission on the Adequacy of Water Supply in the Commonwealth was subsequently created by Chapter 13 of the Resolves of 1977, as signed by Governor Dukakis September 12, 1977.

B. Goals of the Commission

The impetus for the formation of this Commission was the recognition of the need for a systematic, coordinated approach to water resource management for the Commonwealth. Policies calling for such an approach are outlined in the Massachusetts Water Supply Policy Statement and have been adopted by the Governor and the Water Resources Commission. Actions, however, are required to implement these policies. The function of the Commission is to examine water supply decision-making processes in light of the new state policy, identify legislative policies, define the relationship of the state water planning function with regard to regional and local planning in conjunction with federal water policy, and recommend measures in response to the state's most pressing water supply needs.

The Commission recognizes that the establishment of a comprehensive, coordinated water resource management program is ambitious and will require a series of incremental changes over a period of years to be realized. It has decided, accordingly, on a dual focus for its work: to address the most pressing local water issues, seeking short-term solutions which are feasible and can be implemented; and at the same time to identify those initial steps which can be taken toward the establishment of a long-range, comprehensive approach.

C. Activities of the Commission

The Commission held its first organizational meeting in December 1977. Work began with the review of the recommendations contained in the Water Supply Policy Statement and the identification of the most pressing local problems. Commission staff also assisted in the organization of a conference on New England water issues held by the New England Caucus of State Legislators in Concord, New Hampshire in May 1978.

In June, assisted by a full-time research director, the Commission submitted two resolutions on water supply policy to the legislature. The first established water conservation as the cornerstone of the state water policy, consistent with the Water Supply Policy recommendation and with President Carter's newly announced national water policy. The second addressed major water supply augmentation projects, calling for the implementation of conservation measures and the development of all local supply options before resorting to out-of-basin transfers. These resolutions, contained in Appendix 1, were adopted by the General Court on June 27, 1978.

The findings and recommendations contained in the following sections of this report are based on a number of sources investigated by the Commission. The comprehensive background data on the state's water supply systems, current

and projected needs, and problems is contained in the MWSP study, which is hereby incorporated into this legislative report by reference. In addition, the Commission utilized a wide variety of national, state, regional and local studies, plans and reports on water resource issues. These are cited along with other bibliographic references in Appendix H.

The Commission also contacted each town and city in the Commonwealth through a questionnaire on water supply issues. Approximately one-third of the communities have responded, providing additional, updated information to the Commission. In November 1978, the Commission sponsored two public seminars in conjunction with the University of Massachusetts Water Resources Research Center. Held in Amherst and Boston, the seminars provided an opportunity for representatives of local communities and utilities to inform the Commission members of their specific problems and needs. The questionnaire with a summary of the responses and synopses of the seminars are provided in Appendix 5.

Beginning early in 1978, case studies were developed on those communities which were identified as having serious water supply deficits or related problems requiring immediate attention. Local citizens and officials were contacted to determine their attitudes and needs and to gain an understanding of water supply management at the community level. References are made to cases which illustrate various aspects of water supply problems or needs in the section on

Commission findings. Summaries of these studies have been included in Appendix 6.

Finally, input has been received from a number of state agencies involved in water, other concerned legislators, and public interest organizations. Official requests for legislative action from the Special Legislative Commission on the Effect of Present Growth Patterns on the Quality of Life in the Commonwealth and from the Water Resources Commission are contained in Appendix 2.

The following sections report on the findings of the Commission, its recommendations, and the need for further investigation and study of the water resource issues of the Commonwealth.

II. COMMISSION FINDINGS: WATER RESOURCE ISSUES FACING MASSACHUSETTS

A. Introduction

This chapter presents the findings of the Commission based on its investigations to date. The diversity of the issues examined is an indication of the scope and complexity of the water resource management problem. The assurance of continued supplies of high quality drinking water, for example, cannot be sought without regard for the other competing demands on water. These include water for industrial processes, energy production, agriculture, recreation, transportation, aesthetics, and a growing realization of the need to maintain minimum stream flows to sustain aquatic and related habitats, assimilate wastes and provide for other stream uses.

A further constraint on water resource management is the need to coordinate it with other state and local policies. Policies on state and local growth, land use, economic development, agriculture, recreation and solid waste, among others, must be integrated with water supply and resource management policies. The resolution of potential conflicts among these policies will require a continuing commitment of will and effort at both state and local levels.

In many areas the issues which must be addressed are technically and legally highly complex. For example,

practical methods for monitoring water supplies to determine the presence of organic and inorganic compounds are still in the research stage. The health effects of low levels of many natural and man-made substances is also not known. Legally, the contradictions between surface and groundwater laws precludes comprehensive management of water resources, yet the rationalization of those laws involves property rights and legal traditions established over many generations.

As a result the Commission's goal has been to identify those areas for which appropriate legislative reponses could be developed which are practical and can be implemented. Other issues have been raised to indicate the need for further work and the direction of that effort.

The findings which follow are arranged topically and deal with problems which are found statewide. The first issue, the Metropolitan Water supply system, focuses entirely on the MDC system since the issues of supply and demand within that system have a profound impact on the state as a whole.

B. The Metropolitan Water Supply System

1. Overview

Boston's municipal water supply system, one of the first in the nation, was created in the late eighteenth century utilizing Jamaica Pond. As demand grew and local supplies became contaminated, the city moved westward to Lake Cochituate and the Sudbury River, which served the city in the second half of the nineteenth century. By 1895, water supply was recognized as a regional problem in the metropolitan area and the Metropolitan Water District (MWD) was formed with Boston and twelve other communities, the first such district in the country. The Wachusetts Reservoir and Aquaduct were constructed shortly thereafter.

In 1926, the search for additional supplies moved westward again and work was begun on Quabbin Reservoir, an impoundment of the Swift River. Completed in 1939, Quabbin Reservoir has a 412 billion gallon capacity, 85 percent of the system's total, and a 186 square mile watershed, supplemented by the 98 square mile Ware River watershed.

Currently the MWD has 34 member communities and sells to ten other communities as far west as Chicopee. Of the 34 members, 25 are fully supplied, seven are partially supplied, and two have not yet begun to receive water (Woburn and Wellesley, which joined in 1974 and 1972,

respectively. Approximately 2,300,000 people are served by the system.

Under the MWD enabling legislation (Chapter 92 of the General Laws), all communities within ten miles of the state house must be admitted to membership and those within 15 miles of the statehouse are eligible if they can reasonably be supplied with Commission water. The MDC is further authorized to sell water to other communities by separate agreement and to provide emergency supplies (as it has done this year for Bedford.)

2. Current Consumption

The "safe yield" of a water supply system is an engineering design concept indicating the estimated amount of water available during extended dry periods of given severity. It therefore represents a limit which should not be exceeded on a regular basis if adequate supply is to be assured. The safe yield of the MDC water system is estimated to be 300 million gallons per day (MGD). It is currently being exceeded by 17.6 MGD on the average (1977). Peak consumption in recent years hit 479 MGD (August 1, 1975.)

Usage by metropolitan area users averaged 278.4 MGD in 1977; usage for the ten non-member communities was 39.2 MGD for the same year. Consumption over the past ten years has increased from 285 MGD in 1968 to 317.6 MGD in

1977. However, it has been fairly stable since 1972, averaging 314.6 MGD. Consumption for the first ten months of 1978 was just under that for 1977.

Consumption in excess of the safe yield has not caused a problem in recent years because precipitation has been above average (more than 30 inches above average at the Quabbin Watershed from 1972-75.) However, during the drought of 1961-65, Quabbin was reduced to 45% of its capacity. MDC analysis has shown that a recurrence of the drought would drop the level to 31%, based on the higher current consumption levels.

3. Pressures for Expansion

An increasing number of communities in the Boston metropolitan area are facing serious shortages. Stoughton has had a limited water supply for decades and now faces curtailment of growth. Bedford was forced to close four of its town wells when chemical contamination was discovered and has had to rely on emergency supply of MDC water via Lexington. In addition to these crises, a number of towns north and south of Boston are looking to the MDC as the eventual source to augment their limited local supplies. In 1972, the MDC reported a list of 41 communities which might potentially require MDC water in the future. The Corps of Engineers estimated in its Northeast Water Supply Study (NEWS, 1974) that 24 towns in the metropolitan area

might have no other option for supply by 1990.

Population growth and water demand projections, however, have been reduced substantially since the early seventies. The Massachusetts Water Supply Policy study, using 1990 population projections prepared by the Office of State Planning, estimates the further needs of those 24 communities to be 70 MGD as compared with the NEWS study estimate of 141 MGD. Nonetheless, it is clear that the MWD system is under pressure to expand.

Currently, the MDC has plans for a northern extension which would serve two communities and eventually others, and a southern extension which would serve seven communities. The 300 MGD Dorchester Tunnel, activated in 1975, is the first step in the southern extension.

In addition to pressures from metropolitan area communities, a growing number of towns and cities west of Boston are beginning to look to the MDC as a possible source of supply. Worcester now can take MDC water on an emergency basis and may require more when the next dry cycle reduces the yield of its supplies. Amherst is another community which has requested MDC supply as rapid growth in demand due to the pressure of the University of Massachusetts has outstripped its supplies, leading to severe seasonal shortages.

4. Management Issues

The Metropolitan Water System is a large, complex operation which is generally well managed and efficiently run. It supplies very high quality water which requires no treatment to almost forty percent of the state's population. The approach of the MDC until recently has been traditional and oriented toward expansion of supplies rather than the management of demand. More than ten years ago the MDC began planning for a project to divert Connecticut River water by flood skimming during spring flood flows. The diverted water would be pumped to a storage facility at Northeast Utilities and then released into Quabbin Reservoir, ten miles from Northfield Mountain, as needed.

Substantial concern has been generated by this proposal in the Connecticut River valley where residents fear adverse environmental effects and restrictions on Connecticut Valley growth potential might occur. In addition, the State of Connecticut is concerned about impacts on downstream flows and has threatened to take legal action based on its riparian rights. Both the MWSP and the Resolution on Water Supply Augmentation Projects adopted by the General Court June 27, 1978, call for all feasible measures to be taken before such an out-of-basin diversion is adopted. These measures include comprehensive conservation, repair of leaky pipes, and other demand management steps as well as the development of local supply options.

The Commission has explored MDC efforts relating to demand and supply management and has identified both some progress and a number of institutional barriers. These findings include:

° Expansion of District Membership: Section 10 of Chapter 92 which specifies the eligibility of communities within fifteen miles of the state house as noted earlier, is inconsistent with current state policy which has frozen MWD membership. The presence of the statute, however, may encourage communities not currently members of the MWD to view the district as their ultimate solution as local demand begins to exceed supply. Restrictions on expansion of the system based on capacity of supplies would encourage non-member communities to develop other supply alternatives and to better manage existing supplies.

° Control of Leakage: Although the MDC system may have as much as 70 MGD in "unaccounted for" water usage, it is difficult to establish the exact amount lost to leakage. Most of the leaks appear to be within MWD communities, where MDC has no authority over the local distribution systems. To date, the Distribution Section of the MDC Water Division has checked 122 miles of the 250 miles of pipes in the system and found only two leaks. Work is currently limited to a part-time basis due to staff limitations. Additional staff have been requested in the FY 1980 budget to upgrade the program to full-time status.

° Development of Local Self-Sufficiency: In the original enabling legislation, MWD communities were encouraged to abandon their local supplies and prohibited from developing new ones. Though perhaps necessary at the time to insure the financial stability of the new district, these provisions of the law are contrary to current state policy. The City of Cambridge, which utilizes its own supply system almost totally, is legally prohibited from expanding that system because it is a member of the district. The City has requested that this provision be changed. In addition, it may be possible that some of the abandoned supplies could be reactivated for industrial use if not for drinking water. Brookline, for example, owns some 200 wells in Needham which are not now used, and Waltham has abandoned wells in Dedham. These need to be evaluated.

° Conservation Programs: Until just recently, the MDC had no on-going water conservation program to assist and encourage communities in the district to better manage their usage. MDC has recently hired a person under contract to develop such programs. The MWSP study estimates that a full conservation program could save up to 20 percent of current water usage. Such a savings would more than bring the metropolitan system into supply/demand balance, and other hard-pressed communities could be given partial supply.

° Metering: The MDC embarked on a program in 1977 to renovate and modernize their 154 master meters, many of

which were out of calibration or simply not working. The first phase, costing $140,000, is now under way. Eventually, MDC hopes to fully modernize all their meters and add telemetry capabilities so that flow and pressure can be continually monitored, which would assist in locating leaks or breaks. The total cost of the program is estimated to be $3.2 million and will take three to three and one-half years to complete. Currently MDC has $2.1 million available and has requested the remaining $1.1 million in the FY 1980 capital outlay budget. All such costs are borne by the MWD fund.

° The current operating and maintenance budget of the Water Division is $9 million, which covers metering, cleaning and extension of lines. Steel lines installed in the thirties are now deteriorating due to pyrolysis and are being replaced at a cost of $3 million. Preventive maintenance, however, is not currently part of their program. In addition, the total overhaul and rehabilitation of the system's aquaducts could cost several hundred millions of dollars. Given the lack of redundancy in most major lines, not even inspections can take place. Ultimately, the construction of new aquaducts for redundancy will be required. The MDC has requested $15 million for rehabilitation purposes in the FY 1980 budget.

C. Adequacy of Local Supplies

1. Supply Sources and Use

More communities rely on ground water than surface water in the Commonwealth; 55 percent use ground water solely (public systems or private wells) and another 24 percent use partial groundwater supply. Since most of the major population centers rely on surface systems, however, over 50% of the state's population is served by surface water supply. Major communities relying on surface systems include Boston and MWD communities, New Bedford, Fall River, Brockton, Lowell, Lawrence, Haverhill, Fitchburg, Leominster, Springfield, and Pittsfield.

Of the total water used in the state, the U.S. Geological Survey estimates that 39 percent is publicly supplied for domestic and industrial use (22 and 17 percent, respectively); 30 percent is self-supplied for cooling use in thermoelectric power generation; 27 percent is self-supplied by other industrial users; and 4 percent is from private wells for domestic and agricultural use. Total 1970 water usage was estimated to be 1.96 billion gallons per day.

2. Projected Needs

The Massachusetts Water Supply Policy study (MWSP) provides detailed listings of the current safe yields of local supplies, projected demands for 1990, and anticipated needs for most communities in the state. Projections

based on 1990 population projections provided by the Office of State Planning and ones based on local engineering studies are both presented. The OSP-based projections are, in most cases, substantially lower than the more traditional (and often older) engineering estimates. Despite the lowered growth estimates of OSP, water supply deficits are projected for 155 communities in the state by 1990.

Although a number of smaller towns will face critical shortages in the future, the greatest impact on the state's citizens will be from shortages in the metropolitan areas and selected high growth areas. Eighty-five percent of the state's population is located in the metropolitan areas of Boston, Springfield, Worcester, Fall River-New Bedford, Lowell-Lawrence-Haverhill, Brockton, and Pittsfield. These urban areas will have to develop additional supplies by the nineteen nineties to satisfy further projected growth (except for Springfield, which will have an adequate supply) or to deal with declining quality of present supplies. Other high growth areas such as the outer suburbs along Route 495, Cape Cod, towns in the Route 116 corridor through Amherst, and the Berkshire towns along the Massachusetts Turnpike will face increasingly critical supply needs according to the MWSP projections.

3. Efforts to Augment Supplies

Augmentation of existing supplies involves both surface

and ground water alternatives. As noted above, the larger urban systems rely primarily on surface systems which require new impoundments or additional diversions from rivers or streams to augment. The Northfield Diversion, discussed earlier, is one such proposal. The MDC is also exploring expansion of its supplies through the Upper Sudbury River Watershed Project and a diversion of the Millers River. Brockton is proposing to divert the Jones River in Kingston to augment its supplies, which now provide less than one-half day's reserve.

Impoundments are being considered by a number of communities. Lee has been working with the U.S. Soil Conservation Service for ten years on a three-impoundment proposal for Washington Mountain Brook which would provide flood control, recreational and water supply benefits. It is also exploring groundwater alternatives for water supply. In Ipswich a potential reservoir site has been identified which could provide water supply for seventeen towns in that basin. The Town of Ipswich is considering the development of a smaller reservoir on that site to serve just the town.

New England does not have the large, multi-county aquifers found in the mid and far west of the country, but it does have numerous smaller aquifers suitable for individual community supply. Ground water alternatives may be available for many communities, as discussed in greater detail in Section E, below. Cape Cod, for example,

relies solely on its ground water resource since it has no rivers to impound. Except for those served by regional systems, most communities facing current or imminent shortages are already engaged in some kind of ground water exploration. Amherst, for example, is conducting tests to determine the quantity and quality of ground water in the Lawrence Swamp area. Stoughton and Bedford also face critical shortages and have done extensive drilling for ground water to meet their needs, though neither has been successful. North Reading has just identified five new well sites which should solve its supply problem. Unfortunately, there is little long-range water supply planning that is done on the basin level. The diversion of river water and the withdrawl of ground water both have impacts on the total water system of the basin, but these impacts are rarely considered as carefully as the need for new supplies.

4. Efforts to Reduce Demand

Water conservation has been adopted as the cornerstone of the state's water policy, yet no coordinated, statewide program of conservation has been developed. Current conservation practices in individual communities have resulted from local initiatives in response to critical shortages and are not typical of statewide attitudes. However, the public awareness of the need for conservation is growing as a result of these and other initiatives taken by private and public interest groups.

Conservation measures being adopted by some communities include revision of water rates to encourage less waste, improvement of metering where needed, educational programs, and the promotion of water-saving devices. The change in water rates is an essential first step where existing rates are based on declining blocks which charge less as more water is used. An increasing number of communities are going to flat rates as costs rise, and several have adopted or are considering ascending block rates, including Bedford and Holden. The price of water varies widely across the state and is documented in the MWSP study. Rapid increases in the price of water, however, are viewed as a new tax burden and a threat to industrial growth in most communities. Changes will have to be incorporated gradually to avoid costly disruptions.

Other approaches have been adopted as well in towns like Stoughton, Holden and Amherst which have had to face water bans, building restrictions, and similar measures due to critical shortages. Stoughton is currently developing a computerized billing system which will speed delivery of water bills to consumers and provide other water system data useful for better management of demand. Holden is considering a municipal program to provide water saving devices, such as shower heads and faucet restrictors, to its residents to reduce consumption. Amherst has been forced to appeal to its citizens and its university

community for voluntary cutbacks during its seasonal shortages. During the past summer, the University of Massachusetts at Amherst completed the retrofitting of all buildings with water saving devices, reduced shower activity at the school, and shut off air conditioning in fourteen buildings. Amherst is now seeking to institute permanent conservation programs to avoid these recurrent crises until new supplies can be developed.

Other initiatives have also been taken by private groups, one with state support. The Division of Water Pollution Control has funded the Massachusetts Association of Conservation Commissions to develop a series of research and development projects on conservation for local communities where reduced water use will help to solve quality problems by reducing waste water flows. In addition, the Massachusetts Jaycees and the Massachusetts League of Women Voters have embarked on a statewide conservation program in conjunction with ECOS, Inc. of Boston to sell water conserving shower heads and faucet flow restrictors and to promote the efficient use of water.

Among many citizens, however, the perception that water is abundant and cheap and can therefore be wasted persists. As long as one can turn on the faucet and get as much water as one wants at a low price, there is little incentive to conserve. A concentrated public education effort coupled with the adoption of all other feasible

conservation techniques will be required to change this attitude.

The private industrial sector has begun to make the most significant gains through recycling and reuse of water. This has been done largely because of the cost recovery provisions of the Federal Water Pollution Control Act. By reducing waste flows, substantial savings can be realized by concerns which use large amounts of water. Unfortuanately, recycling systems such as that used by the Raytheon Company are expensive to install, and smaller companies may not have sufficient capital to implement them. Technical assistance and encouragement from the state for industrial recycling and reuse could result in substantial reductions in consumption and should be pursued.

5. Summary of Needs

To assure the provision of continued adequate supplies of water in the Commonwealth, the following needs are identified:

° Long-range water supply planning is needed. In many areas this planning needs to be done on a basin or sub-basin basis. Technical assistance from the state or regional planning agencies is needed to coordinate such planning.

° Improved water demand management is needed.

Communities need technical assistance to develop effective, workable conservation programs. Leadership at the state level is required.

° Financial and technical assistance is needed to assist communities in the development of both surface and ground water supplies. Inter-municipal cooperation in the development of supplies should be encouraged where possible and feasible.

D. Quality of Supplies

1. Overview

Concern over the quality of the water supply of the Commonwealth dates to the latter part of the nineteenth century when experiments on water filtration were carried out by the Massachusetts State Board of Health in Lawrence. During this period, an epidemic of typhoid swept the city, especially in the area closest to the Merrimack River. The introduction of sand filtration helped to decrease the incidence of the fever by 79 percent and the death rate from all causes to ten percent. The adoption of chlorination techniques a short time later further insured a safe drinking water supply. Today, water-borne diseases such as typhoid fever have been virtually eliminated. Unfortuantely, new and perhaps even more hazardous elements now threaten our water supplies, posing great risks and challenges to the state's health and economy.

Sources of contamination involve all aspects of our society and include industry, municipal government and agriculture. Over 30,000 chemicals are now being produced, and an additional 1,000 are being added each year. Toxic compounds such as phosphates, nitrates, pesticides, detergents, trace amounts of metals, cyanide, phenols, radioactive wastes, solvents and hydrocarbons are the by-products of our technological age and are increasing threats to our health. Even in low concentrations, these products

represent potential threats to our water supplies if not properly stored and disposed of.

Intrusions into water supplies of oil and other hazardous materials cause degradation of the supply that present technology cannot assess in terms of long-range health effects or economic impacts. Run-off of high nitrate fertilizers, animal feedlot wastes and pesticides are contaminants of particular concern to both surface and groundwater supplies. Control of such non-point sources of contamination is difficult and may be very expensive. However, once groundwater supplies are degraded, they are virtually impossible to correct.

The control and disposal of solid and hazardous wastes is a growing problem which is compounded by the lack of suitable sites and adequate management. Unrestricted, poorly designed landfills can pollute groundwater supplies with highly toxic leachate. There are no designated hazardous waste disposal sites in Massachusetts or in all of New England. Federal regulations on hazardous waste sites and disposal procedures, mandated by the Resource Conservation and Recovery Act of 1976, have not yet been published by E.P.A. and will not become effective before January 1980 at the earliest. Until that time, the state must take a leadership position in identifying and disposing of its industrial and chemical wastes in a manner that precludes the contamination of public or private water supplies.

In addition to the dangers from toxic wastes, a growing number of communities have found it necessary to construct water purification plants to deal with quality problems caused by bacterial wastes, contaminants naturally present in groundwater, and related problems. Thus, the range of quality issues is enormous, posing serious health and financial questions.

The following sections summarize briefly the various water quality issues which have been faced by communities in Massachusetts. These include the storage and disposal of hazardous wastes, monitoring needs, salt contamination, need for protection of supplies, and treatment needs.

2. Storage and Disposal of Materials Hazardous to Water Supplies

A number of cases involving hazardous material storage or disposal have received national attention recently, including the Love Canal chemical landfill case in New York and the Velsical Chemical Company case in Texas. Three recent cases in Massachusetts illustrate the problem faced here.

In Rehoboth, illegal dumping of toxic wastes into a lagoon on the property of a local resident was observed and reported to state authorities. As a result, a Rhode Island trucker, licensed to do business in the Commonwealth,

and the property owner are being sued by the state for $200,000 for clean-up costs and damages. Two private wells in the immediate area have been forced to close, forcing these citizens to transport water to their homes. In addition, Shad Factory Pond, a source of water for Bristol County, Rhode Island, is being monitored regularly for possible pollution.

In Lowell, the Commonwealth is spending $1.5 million to clean up a five acre site containing 20,000 barrels of poisonous chemicals abandoned by a bankrupt company. Environmental degradation has not yet been fully assessed. The chemicals will be removed from the site and transported to a waste disposal site in New York or New Jersey. A recent EPA study has estimated that there are hundreds of potentially dangerous dump sites in New England, many old abandoned landfills which contain toxic materials which can leach into ground water. The potential danger of these old sites to water supplies may be enormous and must be addressed.

Perhaps the most dramatic example recently of the need to regulate the storage of hazardous materials is in Provincetown. In December 1977, this cape community which already suffers from natural salt intrusion and an inadequate summer water supply, discovered that gasoline from a corroded 22 year old gasoline storage tank in North Truro, 600 feet from its water supply, was leaking an undetermined amount of gasoline into the ground. No gasoline was

found in the well field itself, but tests located almost pure gasoline in the ground beneath the spill and varying quantities of gasoline in the water table between the spill and the well field. Gasoline was also found adhering to soil particles where it could be leached out by rain or melting snow. According to the town manager, "Test pumping of the South Hollow Well Field has also shown that pumping of the station at anything approaching its normal rate would draw gasoline now in the water table into the well field, rendering it useless as a source of water for many years to come. To prevent this result, the South Hollow Well Field has been substantially out of commission since the discovery of the gasoline leak."

Through the cooperation of the National Park Service, the U.S. Air Force, and the Massachusetts Civil Defense Agency, emergency supplies were provided from the National Seashore and the North Truro Air Force Station before July fourth and the peak summer demand. Since these pipes are laid above ground, they cannot be used during the winter. Although the emergency supplies will again be provided next summer, Provincetown is under pressure to return their wells to production as soon as possible. The town has hired a consultant who proposes to pump the liquid gasoline out and to remove the gasoline which is adhering to soil particles by a bioreclamation process. Nutrients will be pumped into the ground to

enable bacteria already present in the soil to consume or digest the gasoline. The process is relatively new but has been used successfully in New Jersey and Pennsylvania.

The Town of Providence has made direct appropriations of $43,000 and has authorized the borrowing of an additional $670,000 to deal with these problems. As Mr. Cobb, the Town Manager, communicated: "The need to appropriate amounts of this magnitude in a period of rising tax rates and mounting dissatisfaction with them is certain to cause political problems of dimensions yet unpredictable, and is likely to interfere with the Town's willingness to address itself to its already serious structural and administrative problems."

Several issues have been raised by this episode. First, although the Division of Water Pollution Control has a statutory duty to clean up oil products spilled in the waters of the Commonwealth under Section 27 of Chapter 21 of the General Laws, the Division could not be persuaded by the town to take any action, nor would the Division join the town in a lawsuit against the parties responsible for the spill. Second, the licensing of gasoline storage tanks and the regulation of their siting and inspection to prevent leakage into the soil or water supplies appear to be totally inadequate. Current provisions are concerned almost solely with fire danger and public safety, not public health.

Although Provincetown is exploring other well locations in Truro with the assistance of the U.S. Geological Survey and may be able to develop an alternative supply, its summer needs probably exceed the capacity of the local aquifer, and over-withdrawls will ultimately result in salt water intrusion into the aquifer. Clearly, supply alternatives need to be developed in cooperation with other communities. However, the cost of this one spill and the possibility of losing the present well field altogether put the town into a very precarious position. The need to respond to the current crisis may well preclude other long-range solutions which would be better.

3. Monitoring Needs

Another recent case of chemical contamination illustrates the need for better monitoring of public and private water supplies. In Bedford a local chemist doing a research project sampled water from one of the town wells and discovered dioxane, an industrial solvent suspected of being carcinogenic. When notified of this discovery, the town had the other wells in the well field tested and found other contaminants as well, including tetrahydofuran, trichlorochlyem and trichloroethylene, all highly toxic.

The Town of Bedford immediately shut down the four contaminated wells and initiated a search for the sources. The Department of Environmental Quality Engineering

was asked for assistance and has provided some testing of samples over the summer. The wells cannot be returned to service until there is assurance that the contaminants will not recur. However, it appears that they may be in the ground surrounding one or more industrial establishments near the area, since contaminant levels rise dramatically following rains as they are leached out of the soil into the recharge area of the wells. Meanwhile, Bedford has been receiving emergency supplies of water from the MDC through Lexington, but at very high cost. There is no indication of when the wells might be returned to service, though the town has a consultant working on the problem and the local industries are cooperating.

The question raised by one of the members of the Board of Selectmen to the Commission is how many other communities may have similar pollution problems but not know about it. The issue is a very difficult one to resolve, given the enormous number of substances which could find their way into a supply. National research is being conducted to develop "surrogate" indicators which would allow limited testing to indicate the presence of undesireable materials. To date, however, there has been no success. Another approach would stress preventative measures, including the protection of all recharge areas. However, toxic materials can travel great distances in groundwater before reaching a water supply, so source control is ultimately required.

4. Protection of Supplies

All of the cases noted above have involved the need for protection of water supplies. Another current case stresses the point also. In Shirley a large gravel company proposes to remove millions of cubic yards of sand and gravel from an area which is adjacent to wetlands and which, when mined, could affect local water supplies. The Shirley Conservation Commission has set out a very stringent Order of Conditions which must be followed, but the company is appealing that order. It appears that now, before any irreversible actions are taken, the long-range impacts of such projects should be determined. The Shirley case will be a precedent-setting case for protection of water supplies under the Inland Wetlands Protection Act.

The issue of the need to protect water supplies has also been raised repeatedly in conjunction with contamination from road salting operations. A Special Legislative Commission on Salt Contamination reported in 1973 that road salt was the most probable cause of salt contamination of groundwater supplies. U.S. Geological Survey studies have established a relationship between the rise in salt contamination in the state in the last fifteen years with the increased usage of de-icing chemicals.

A number of public and private wells have been lost due to road salt contamination, including ones in Weston,

Goshen, Auburn and Pelham. In addition, the Town of Burlington banned the use of salt when it found its water supply was being contaminated by runoff from salted roads. The reservoirs of the City of Cambridge supply are located at the junction of Routes 2 and 128 and have very high salt levels.

The state has responded by establishing a Snow and Ice Control Task Force under the auspices of the Department of Public Works. All state agencies which utilize salt sit on the Task Force and develop plans to minimize harm from the salting program while meeting their public safety goals. Statistics for 1977 show that sodium levels have declined as compared with previous years. This is apparently the direct result of a decline in the quantity of chemicals applied to the roads. However, approximately 42 percent of the municipalities outside the MDC have chloride levels exceeding 15 miligrams per liter. Medical evidence suggests that persons suffering from heart disease and related illnesses should not drink water with more than 20 miligrams per liter of sodium. The state of Massachusetts has also adopted that standard and residents must be informed by their water departments if the standard is exceeded.

The state has also instituted a program for building salt storage sheds to prevent leaching of salt into local groundwater. Salt usage by all parties in the state who use more than one ton per year must be reported to the

Division of Water Supply as well. However, most municipalities have never complied with these regulations, so the state's knowledge of exactly how much salt is being use and where it is being placed is limited. Further attention should be paid to minimizing salt usage and run off in the vicinity of water supply recharge or drainage areas. Enforcement of the reporting requirements will be necessary to begin to accomplish this goal.

5. Treatment Needs

Currently most communities which treat their drinking water do so to purify it of bacterial contamination or to remove minerals such as iron and manganese. The need for financial assistance for treatment plants was recognized by the legislature in 1978 with the passage of Chapter 406, which provides matching grants to communities for construction of water purification plants. A large number of communities need such facilities and are in the process of making application to the Division of Water Supply which administers the grant program. Since no grants have yet been made under Chapter 406, it is difficult to determine the ultimate need. However, it appears that the initial bond issue of $75 million will meet only a portion of the total need.

6. Summary of Needs

The following needs relating to maintenance of

water supply quality have been identified by the Commission investigations and by local community input to the Commission:

° Improved state and federal regulation of the storage and disposal of hazardous materials with particular attention to protection of water supplies. Existing state regulations should be reviewed and strengthened.

° Improvement of the state's regulations concerning oil and gasoline storage and spills. There is a pressing need to review and inspect gasoline storage at the thousands of stations built after World War II, many of which may have corroding storage tanks.

° Research on practical and affordable methods of monitoring the quality of public and private water supplies; improved state testing facilities and more staff to assist communities.

° Technical assistance to communities to assist them in identifying critical aquifer and recharge areas which need protection to prevent pollution.

° Improved reporting of salt usage statistics by all state agencies, municipal and private users, and increased attention to prevention of salt run off into water supplies.

E. Groundwater Issues

1. Introduction

As noted in section C, above, more communities in the Commonwealth rely on groundwater than on surface water for their supplies. Fifty-five percent rely solely on groundwater with an additional twenty-four percent using partial groundwater supply. While over fifty percent of the state's population is served by surface water, as in the MDC system, it is clear that groundwater is a critical element in the state's water supply system. Accordingly, this section deals only with groundwater issues and identifies the pressing need to upgrade our data base and capability to utilize these supplies. A more detailed technical description of groundwater, including its critical relationship to surface water, is included in Appendix 4.

2. Availability of Groundwater

Recognizance studies conducted by the U.S. Geologic Survey and the Water Resources Commission indicate potential sources of groundwater supply for many basins in the state. Groundwater supplies in the metropolitan Boston area have been largely developed or have been contaminated by intensive urban development. Much of the groundwater in the greater Boston area has high iron or manganese content, but can be treated. The most extensive

groundwater resources occur on the South Shore coastal areas and on Cape Cod, where they represent the only source of supply. In central and southeastern Massachusetts, groundwater sources tend to be scattered and of low yield, whereas in the Connecticut River valley and in the western part of the state, groundwater potential appears to be substantial. In all of the river basins of the state, however, groundwater sources occur which have the potential for individual community supply augmentation. Yield and quality of these resources can be determined only by detailed groundwater assessments which, unfortunately, have not been done in most areas.

3. Advantages of Groundwater Supplies

In most communities where groundwater is available, its development for supply has significant advantages over surface water alternatives. First, the capital and operating costs of installation are far less than for surface reservoirs unless extensive well fields are needed. Second, groundwater supplies provide much greater flexibility; wells can be drilled as demand increases whereas reservoir capacity cannot easily be built in stages. Third, surface water reservoirs eventually become filled with silt and other organic matter, and water quality deteriorates. A properly managed groundwater source will last indefinitely. Fourth, groundwater is usually of better quality than surface water due to natural purification capacity of the soil, assuming

proper protective measures are taken for the recharge areas. Fifth, groundwater systems occupy a fraction of the land required for surface reservoirs; protected recharge areas can provide valuable green belts for a community. Finally, groundwater supplies can be developed in a fraction of the time required for surface reservoirs, an important consideration in drought contingency planning.

Groundwater supplies do have certain limitations. If withdrawls exceed the yield of the recharge area for any length of time, an aquifer can be depleted. In coastal areas this can result in salt water replacing the potable water, making the source unusable. Also, the recharge area of an aquifer must be properly protected to maintain its yield. If it is covered with pavement or other impervious materials, the yield of the source will decrease proportionately. Finally, if a groundwater source becomes contaminated, it may be lost for many years, whereas a surface system can be flushed out. Nonetheless, the advantages of groundwater supplies, where available, tend to make them preferable to surface alternatives.

4. Relevant State Policy

The Massachusetts Water Supply Policy states that "...local supplies should be conserved and local resources should be utilized before resorting to more elaborate long-distance transport of water and diversions from other watersheds." This policy has been confirmed by the resolution of

the General Court on Water Supply Augmentation Projects, adopted June 27, 1978, which calls for development of all local supplies before diversions are considered. The full and effective utilization of the state's groundwater supplies is an integral part of Massachusetts water policy.

5. Legal Issues in Groundwater

The relationship between ground and surface water is poorly understood generally and completely ignored in water law in Massachusetts. Groundwater is treated as a separate resource, yet in reality it is a critical element in a drainage system, storing water during wet periods and slowly releasing it during dry periods to maintain stream flows. This relationship is readily apparent in the case of the Ipswich River basin where, during extended periods of summertime pumping by the Reading wells adjacent to the river, it goes dry and begins to flow backwards further downstream.

Because of the legal definition of groundwater, which is based on English Common Law, groundwater withdrawls are not regulated to maintain necessary minimum stream flows or pond levels. Treated legally as a mineral, the owner of the overlying land may draw as much groundwater as he wishes, even if such withdrawls cause a neighbor's well to go dry. Surface water, on the other hand, falls under riparian doctrine which allows adjacent (or riparian) owners

to use only "reasonable" amounts of water which must be returned to the body of water in substantially the same amount and quality. In addition, the state over time has come to assume the ultimate responsibility for all navigable waters (all rivers and streams) and all Great Ponds (those greater than ten acres.)

Proper and efficient management of the total water resource of the Commonwealth is not possible, particularly in areas of high demand, without the conjunctive management of ground and surface water. For that to occur, groundwater and riparian law must be made consistent with one another. Groundwater legally must be considered a public resource under the stewardship of the overlying land owner so that the "reasonable use" doctrine can be applied.

6. Lack of Adequate Groundwater Data

The lack of adequate, detailed information on aquifer locations and yields, groundwater flows and recharge areas has resulted in a wide range of problems in communities, several of which have been noted in the preceding sections. In order to manage and protect present supplies, an aquifer and its recharge area must be protected from contamination. Many groundwater supplies, particularly in the eastern, developed portions of the state, have suffered from sewerage system leakage, urban contaminated runoff, highway salting, paving of recharge areas, and chemical contamination.

The contamination of wells in Bedford and Provincetown described in section D are examples of this.

In many communities there is a desire to enact protective measures but a lack of knowledge about the exact location of areas needing protection is lacking. Wareham, Holden, Amherst and Leominster are a few of the communities which have indicated a desire for assistance in obtaining data appropriate for this purpose. In some instances, local towns have retained private consultants to develop this information, as in Hanover, Stowe and Shirley. A related need for adequate groundwater data is to allow communities to identify future sources so they can be protected and, conversely, to identify areas appropriate for development, where potential water supplies will not be degraded.

The costs to communities of inadequate data and understanding of the groundwater system are substantial. Many communities appropriate money year after year for groundwater exploration. However, the programs developed by these communities for seeking groundwater are frequently not well-founded in geological or hydrological data. Cases have been brought to the attention of the Commission in which test wells have been place in nearly the same place repeatedly over a period of years. Yet in other cases, such as North Reading, a competent hydro-geological survey resulted in the identification of five potential wells with supplies adequate to meet the town's needs after it had been

informed by previous consultants that it had no groundwater supply potential and should look to the MDC. A coordinated, professional approach to groundwater assessment statewide is one of the most cost-efficient approaches to meeting much of the state's future supply needs. Such an approach should be integrated into overall water resource planning at the state level rather than being the responsibility of one of several agencies and divisions which have water planning functions.

7. Summary of Needs

The two major needs relating to groundwater are:

° The development of a professional, statewide groundwater survey program to provide data to enable communities and regions to develop their local water resources wisely and efficiently.

° Redefinition of groundwater law to make it consistent with surface water law.

F. Water System Infrastructure Issues

1. Overview

The single greatest need of the older cities and towns in the Commonwealth is for financial assistance for the rehabilitation of their water distribution infrastructure. This need has been expressed repeatedly to the Commission and is documented in the Massachusetts Water Supply Policy study. The age and condition of water distribution systems are a major concern of many municipalities. Elected officials and engineers in these communities fear that system deterioration involving valve leaks and breaks, pipe leaks and breaks, and pump breakdown is increasingly undermining their communities' ability to distribute adequate supplies of water to users within their jurisdictions. In order to maintain the economic viability of their communities and to compete with more recently developed areas, officials in the state's older communities and urban centers realize that their distribution systems must be renovated.

Another source of concern arising from this issue is the potential health hazard posed by antiquated distribution systems. Poorly lined, or more commonly, unlined pipes often contaminate water with iron metal. The unhealthy effects of water transported through lead pipes has been well documented. Finally, heavily encrusted pipes, in addition to restricting the flow of water through them,

provide areas where bacteria can accumulate and multiply to a harmful extent. Poorly designed systems which have sections of pipe with little or no circulation contribute to water quality problems of this type, as well.

A third concern involves issues of public safety. Old, encrusted pipes no longer provide the flows they did when new. It is common that eight inch pipes laid fifty to one hundred years ago will have been reduced to the capacity of a four inch pipe or less. In addition, many of the older portions of municipal systems are now inadequate to meet current needs. The result of these inadequate pipes is inadequate pressure to provide fire protection, as in the City of Lynn.

Finally, the cost of water lost through leaks in water distribution systems represents a major impetus for rehabilitation. The cost of obtaining additional water, whether from sources within the community or through importation, is often too great to justify water losses which are correctable. Within the MDC system, for example, it is estimated that approximately 70 MGD are unaccounted for losses. If one-half of this unaccounted for water is being lost to correctable leaks, the savings would more than bring the system into demand/supply balance. Indeed, the proposed Northfield Diversion will provide 72 MGD over the course of a year. Conservation through leak correction could well defer the need for such supply augmentation.

This section presents the Commission's findings regarding infrastructure needs and particularly costs. It focuses on distribution system rehabilitation since an assistance program has already been established for treatment plants in Chapter 406 of the Acts of 1978.

2. Condition of Infrastructure and Need

A survey of Massachusetts cities and towns indicates that the need for major system rehabilitation work is widespread. Of the 72 communities for which information could be obtained, 33 have water distribution systems of which more than half is over fifty years old. Twenty-two communities estimate that one-quarter or more of their distribution system requires immediate replacement or major repair work.

The Commission's survey also indicates that the communities cannot afford the cost of repairing or replacing large parts of their systems. Table II-F lists the estimated costs provided by the responding communities which had such information available. The quality of the estimates varies considerably since some communities have had recent engineering studies done to establish needs and others have not. Comparison of the total cost estimated and current annual expenditures illustrates the inability of most local governments to adequately address the increasingly critical rehabilitation problem.

Table II-F. Estimated System Needs and Current Expenditures for Selected Communities

City or Town	Total Estimated System Need	Current Annual Expenditures
Beverly	$ 16,500,000	
Boston	100,000,000	$5,000,000
Brookline	27,000,000	
Cambridge	30,000,000	
Chelsea	2,000,000	
Fall River	22,000,000*	70,000
Fitchburg	8,000,000	
Gloucester	3,000,000	
Lawrence	5,000,000	
Leominster	2,500,000	300,000
Lowell	12,000,000*	
Lynn	21,000,000	150,000
Malden	7,000,000	0
Milton	1,500,000	70,000
New Bedford	24,000,000	300,000
Newton	20,000,000	30,000
Peabody	11,000,000*	
Pittsfield	17,500,000	400,000
Quincy	30,000,000	1,300,000
Salem	10,000,000	
Somerville	2,000,000	
Springfield	8,000,000	0
Swansea	1,000,000	175,000
Taunton	43,500,000*	1,500,000

(* Includes cost of treatment plant or reservoir)

The system costs listed in Table II-F are far more substantial than the costs of water treatment plants. In Lynn, for example, the new treatment plant cost is $14 million but required system rehabilitation will total $21 million. The Town of Pittsfield has a similar need. A recent engineering study laid out a 17-year program for system upgrading which averages $1,025,000 per year. The town has just appropriated $400,000 to begin the job.

Costs vary considerably, of course, depending on the type and location of construction. Boston estimates that 212 of the 1,080 miles in its system need major rehabilitation or replacement now. They estimate an average cost of $90 per foot, or $475,200 per mile. By contrast, Fall River just received estimates for cleaning and relining of pipes which came to $40 per foot, up from $16 per foot for the same work a few years ago.

3. Leak Detection Programs

An important part of any community's rehabilitation effort should be in leak detection. Undetected losses can cost far more than the cost of repairs. The Commission survey indicates that few communities have regular leak detection programs; most respond to breaks when notified. Several towns and cities do conduct leak detection on a regular basis, however. Boston spends approximately $55,000 per year for this purpose; Hanover spends $7,500. Two communities,

Arlington and Malden, have instituted regular programs which document their cost-effectiveness.

In three years (1975-77) Arlington spent $11,100 and realized a total savings of $112,000 per year from water saved, a tenfold return of the leak detection expenditure in one year. Malden, which does a complete survey every three years, spent $13,500 in 1978, found 66 leaks, and will save 1.27 MGD or $110,880 per year.

The MWPS study stresses the need for a major leak detection effort in the state because of the potential reduction in water demand. The Commission agrees that it can be a very effective water conservation measure. It is also evident, however, that leak detection is extremely valuable and can be justified on its cost-effectiveness alone.

4. Summary of Needs

A partial indication of the needs for system rehabilitation is provided in Table II-F. Clearly, a large construction program is called for over a period of twenty years or more. Given the pressing need for repairs in many communities, and the benefits of reducing consumption through repair of leakage, it is crucial that a limited rehabilitation assistance program be initiated by the state. It is also essential that the Governor and the Legislature exert continued pressure on Federal officials and Congress to provide a Federal construction grants program for this purpose.

G. Water Resource Management Issues

1. Local Issues

The responsibility for water supply development and delivery is primarily a local one in Massachusetts. The actual supplier at the local level varies considerably, however, across the state. Approximately six percent of the state's population is self-supplied with on-lot wells. These supplies are essentially unregulated except for local health regulations. A total of 74 private water companies operate in the state. These are licensed by the Department of Public Utilities and must file an annual report, but beyond that they are very independent. There are also 79 local water and/or fire districts which serve 53 communities. Finally, 193 towns are served solely by a municipal water department and ten towns have a water department and are also supplied by another water company or district.

Most communities in the Commonwealth manage their water supplies by themselves. A number of municipalities are involved in regional systems, however, and a much larger number import water from beyond their borders (114). In these cases some constraints are placed on the options a community can follow. In general, towns do not engage in explicit, coordinated water resource management planning. Water departments tend to be run by professionals who are

left to do their job. Water resource management does not become an issue until a crisis strikes.

The Water Resources Commission adopted regulations on December 11, 1978, which call for the development of comprehensive water resource management plans for all basins in the Commonwealth. It will be the responsibility of the WRC to prepare these plans. The regulations also call on municipalities to prepare similar plans for themselves, though they are not obligated to do so. This Commission agrees that the initiation of such planning at the local level is a necessary step toward rational management of the state's water resource.

2. State Issues

One of the primary reasons for the formation of this Commission was the lack of a coordinated, comprehensive approach to water resource management at the state level. The issue is well stated in the MWSP study: "Today in the Commonwealth, critical water supply decisions are made at every level of government in the absence of coordinated water resource information and without adequate knowledge of long-range economic and environmental considerations. The uncoordinated management and the incremental patchwork approach to developing water supply systems are the result of overlapping and poorly defined responsibilities of various agencies, districts, commissions, and departments.

Administrative conflicts over allocation of water resources among various incompatible uses have presented basic management problems. In the absence of fundamental statistics and projections, water is allocated through legislative action on a first come, first served basis with little formalized review of competing needs or foreclosed options. ...Much of the present state administrative structure has expanded in response to multiple demands of federal legislation. The legislation, added to existing state statutes and the local demands of water users and conflicting interest groups has created a tangle of departmental responsibilities. The further compartmentalization of water related activities within departments has produced a series of single purpose programs and highly specialized projects."

This fragmentation and compartmentalization are responsible at least in part for the lack of a serious effort at the state level to develop conjunctive management of ground and surface water, mentioned earlier. It also appears to partially explain why Massachusetts has such an inadequate hydrological data base and no data management system at all.

Over the next two to three years, EPA intends to delegate all of its federal water program administration to the states. In this process agreements will be made between EPA and the state as to how the state intends to manage all of its water related programs. It appears that the formulation of these agreements presents a genuine opportunity

for the administration and the legislature to take a close look at the administrative structure of the water related agencies and to reassess their functions.

3. Summary

The Commission supports the recommendation of the MWSP study which places the lead responsibility for water resource planning in the hands of the Water Resource Commission until more substantial restructuring can occur. We see the need now, however, for the formation of an integrated, coordinated water resource planning function at the state level. Such a body would bring together the planning functions which are now fragmented among so many agencies and divisions.

III. COMMISSION RECOMMENDATIONS: TOWARD A COMPREHENSIVE WATER RESOURCE MANAGEMENT PROGRAM

A. Introduction

The Commission's findings, described above, indicate the need for a massive overhaul of the state's approach to water supply and water resource management. Yet, limitations of time, resources and the political process place practical constraints on what can be accomplished in the immediate future. The process of developing a rational, balanced approach to water resource management will take time. Considerations of cost, equity, economic development needs and citizen support must be weighed together with all of the state's other policies and priorities which might be affected at each stage of the process.

The recommendations for legislative action which follow therefore address what the Commission believes to be the most pressing problems relative to continued adequacy of water supplies in the Commonwealth. The themes under which they fall include demand management, supply management and administrative management. The recommenations are organized in three categories: those relating to improved management of the MDC water supply system; those providing technical and financial assistance to communities; and those improving state regulations and management capabilities relative to water supplies.

The first set of recommendations concerns the MDC water system and attempts to improve its management by encouraging water conservation and self-reliance. The basic authorizing legislation is amended to preclude abandonment and to allow local communities to develop alternative supplies. Also, an MDC Office of Water Conservation is established to promote conservation within the district. Most important, no further expansion of the already strained system is allowed until the system's supply and demand are in balance so that future demands on the system can be met.

The second set of proposed measures provides technical and financial assistance to communities to better enable them to solve their local water problems. Again, water conservation is a cornerstone element because the management of demand will alleviate current critical shortages, reduce the need for future, costly additions to supply, and provide additional time for the development of long-range approaches. Two major needs which are also addressed include improvement of the state's geological and hydrological data base, to assist local communities to develop new supplies, and the provision of financial aid for leak detection and system rehabilitation. In addition, greater flexibility in municipal financing of water projects is recommended.

The third set of recommendations addresses state regulations and management capabilities. Water saving plumbing fixtures are recommended for all new installations.

Improved regulation of hazardous materials and groundwater contamination is addressed in two bills relating to the Department of Environmental Quality Engineering and the Division of Water Pollution Control. To improve administrative capabilities and management, the Commission recommends three measures. First, drought contingency planning is added to the responsibilities of the Water Resources Commission. Second, the adoption of local water resource management plans, pursuant to Water Resource Commission regulations recently adopted, is made a criteria for state aid eligibility. Finally, the Commission recommends the establishment of an integrated water resources planning group to gather together existing water planning functions now scattered among a variety of agencies which deal with water.

Several of the recommendations of this Commission modify existing legal authority to bring it into line with current state or agency policy and will place no financial burden on either the state or local communities. These should be adopted forthwith. Some of the recommendations, such as the restructuring of existing planning functions, will require no new positions or funding and, in fact, will result in greater productivity and effectiveness.

A number of the recommendations do call for new expenditures, particularly the bills dealing with groundwater surveys and system rehabilitation. While it may appear

ambitious to call for new expenditures at a time when there are so many demands on our limited financial resources, the Commission feels that failure to begin to address these critical needs now will have far-reaching adverse impacts. The development of local supplies, for example, is essential to maintain the economic viability of many water-short communities. Similarly, the costs of antiquated distribution systems include growing water losses, lack of adequate pressure for public safety, and danger to the public health. It is essential, therefore, that we begin to invest now in this vital infrastructure if we are to avoid the incalculable costs of future crises.

The remaining sections describe each of the recommended legislative actions in detail with cost impacts and other relevant data. The proposed legislation is contained in Appendices A - N.

B. Recommendations to Improve the Management of the Metropolitan Water District

Demand Management:

1. Regulation of Metropolitan Water District Membership (Appendix A)

As noted above in Section II, the MDC water system is currently delivering more than 17 MGD in excess of its safe yield on the average. This imbalance between consumption and supply has existed since 1969. Two years ago the Secretary of the Executive Office of Environmental Affairs declared a moratorium on further hookups to the system until this imbalance was corrected.

Under Section 10 of Chapter 92, the MDC is obligated to supply all towns within ten miles of the state house and all those within fifteen miles which it can "reasonbaly supply." The Commission's intent in this recommendation is to amend Section 10 so that the MDC cannot admit any new members, or sell water to other communities, unless the average yearly consumption in the system is below its safe yield.

The proposed act is titled "An Act Further Regulating the Provision of Water by the Metropolitan Water District." Section 1 of the act amends the first paragraph of Section 10 of Chapter 92 by adding the words "which the commission can reasonably supply with water" to

qualify the provision of district membership for towns within ten miles of the state house. It adds the further qualification, "provided that no new members shall be admitted unless average yearly consumption of commission water is below the calculated safe yield of the system," to define the exact conditions under which new members may be admitted.

Section 2 of the act adds the same qualifying phrase to the third paragraph of section 10, which deals with MDC provision of water to users beyond the 15 mile limit. The remainder of paragraphs (1) and (3) are unchanged. Section 3 provides that the act shall take effect on its passage.

There are no financial implications of this act for the MDC, district members or the state. Communities hoping to receive MDC water will be forced to develop other alternatives, including better management of demand, until the MDC system is in balance. This is consistent with state water policy. It should also be noted that this act in no way alters the MDC's authority to provide water in emergency situations, as provided for in paragraph (4) of section 10 of Chapter 92.

2. Creation of An Office of Water Conservation Within the MDC (Appendix B)

The need for serious, coordinated efforts to

reduce water consumption is the cornerstone of both state and national water policy and has been discussed in a number of different contexts in Section II. Since the MDC is the largest regional water supplier in the Commonwealth, serving forty percent of the state's population, and has a serious imbalance between supply and demand, it is appropriate and necessary that it have an office of water conservation within its operational structure. Ad hoc approaches and consultant contracts will not have the impact of a permanent office within the organization.

The office is intended to provide leadership within the MDC organization and for member communities to encourage a wide variety of conservation efforts. Such an office will be able to develop educational materials to promote conservation, explore pricing structures and other incentives for reduction of consumption, encourage recycling and reuse among industrial users, and make recommendations to the Commissioner for needed changes.

"An Act Providing for the Designation of an Office of Water Conservation Within the Metropolitan District Commission" amends Chapter 92, MDC's enabling legislation, by adding a new section 15A which establishes the office with a director not subject to civil service who will be appointed by the Commissioner. It also defines the purposes of the office and sets requirements for an annual report.

Section 2 of the act provides that it shall take effect on its passage.

Funding for this office will include salaries for the director and other staff employed and operating expenses for office, printing, supplies and similar overhead. Given existing MDC office space and overhead and the opportunity to utilize existing support staff, the office of water conservation could be established initially for an addition of $42,000 to the MDC general maintenance account. This would provide for a director and a principal planner with allowance for expenses other than normal overhead, such as printing. The exact level of funding is not specified in the act since it should be established in the normal budgeting process where it will receive annual review for effectiveness.

All costs of this office will be paid out of the Metropolitan Water Fund and represent no burden on the General Fund. The potential benefits to the MWD communities, however, are very substantial and justify the expenditure. Savings will accrue to district communities from lowered consumption and the possible deferral or elimination of the high costs of providing additional capacity to meet marginal demands. Finally, the value of bringing the consumption of the MDC system into balance with its supply is by far the most cost-effective element of needed drought contingency planning.

Supply Management:

3. Abandoned Water Supplies (Appendix C)

The state water policy calls for the development of all local supplies in a basin before resorting to inter-basin transfers for supply augmentation. To further this policy, the Commission recommends that all supplies abandoned by communities on joining the district be evaluated for potential reactivation, and that the statutes governing the Metropolitan Water District be amended to prohibit such abandonment in the future, which is current MDC policy.

"An Act Concerning Abandonment of Water Supplies in the Metropolitan Water District" addresses both of these concerns. Section 1 of the act amends section 10 of Chapter 92 of the General Laws by striking the seventh paragraph which provides for abandonment and replacing it with a new paragraph (7) which prohibits abandonment except when a supply is declared unfit by public health officials and cannot be restored. Section 2 of the act strikes paragraphs (8), (10) and (11) of section 10 of Chapter 92, all of which deal with procedures to be followed when supplies are abandoned.

Section 3 of the act direct the MDC to undertake an investigation of all abandoned supplies in the MWD to determine their suitability for use as potable or industrial process supply. Results of the investigation are to

be reported to the Governor, the Legislature, the Secretary of Environmental Affairs, and the Water Resources Commission and to be made available to the public within one year of passage of the act. Section 4 of the act provides that it shall take effect on passage.

Sections 1 and 2 of this act, which amend MDC legislation to make it consistent with current policy and MDC practice, involve no financial expenditures. Section 3 requires the expenditures of funds to conduct the required study of abandoned supplies. The cost of this study has not yet been determined; however, since it is one of the elements required in the Northfield Diversion Project Environmental Impact Report, which has current funding, no other expenditures will be required.

If any of the abandoned supplies are determined to be suitable for domestic or industrial use, their addition would represent a benefit to the district by lowering the demand on the over-extended MDC system.

4. Development of Additional Supplies (Appendix D)

The last recommendation of the Commission which relates directly to the Metropolitan Water District is also intended to make MWD enabling legislation consistent with current state policy. Under section 16 of Chapter 92 of the General Laws and section 23 of Chapter 488 of the Acts of 1895, MWD communities within ten miles of the

state house are prohibited from using any source of water not in use at the time they joined.

Section 1 of "An Act Permitting Metropolitan Water District Member Communities to Develop Additional Supplies to Augment the Water They Receive From the Metropolitan Water District" voids section 23 of Chapter 488 of the Acts of 1895. Section 2 of the act amends section 16 of Chapter 92 by striking the first sentence and replacing it with language which allows the use of other sources of supply.

This measure places no financial burden on the Commonwealth, on the MDC, or on MWD members. It will allow, however, communities such as Cambridge to explore the possibility of enlarging their existing water system, which would reduce potential future pressure on the MDC system.

C. Recommendations to Provide Technical and Financial Assistance to Communities to Insure Continued Adequacy of Water Supplies

Demand Management:

1. Creation of a State Office of Water Conservation (Appendix E)

In order to implement our state and national policy on water conservation effectively, the Commission recommends that a state office of water conservation be established under the jurisdiction of the Water Resources Commission (WRC), which is responsible for overall state

water policy. The primary function of this office would be to provide direct technical assistance and leadership to communities, water districts, utilities and conservation commissions to establish water conservation programs. While it would coordinate its activities with those of the MDC office through WRC oversight, it would serve the non-MDC communities.

Efforts of the proposed office would include public education programs, investigation of pricing policies and their affect on demand, evaluation of water-saving techniques and fixtures, promotion of recycling and reuse in industry, and examination of possible regulatory changes in other state agencies to promote conservation.

Section 1 of "An Act Establishing a State Office of Water Conservation" amends Chapter 21 of the General Laws, which defines the responsibilities of the WRC, by adding a new section 11A. The new section establishes a state office of water conservation under the WRC, headed by a director not under Civil Service who is appointed by the WRC. The office is authorized to employ staff and to develop policies and programs to further water conservation. The office is also authorized to receive grants from federal, regional or other governmental or private sources for its purposes. Section 2 of the act provides that it take effect on passage.

Specific Funding levels are not specified in the act because the Commission feels that funding for such an office should be established in the annual budgetary process after a review of effectiveness. Initial start up costs for the office should include a director, a principal planner and a secretary; office space and supplies; telephone, printing and related operating items. Ideally, funds should be provided for consultant services to allow for special studies, projects, etc. Excluding funds for such consultant services, minimal start up costs are estimated to be approximately $58,000 per year.

Besides providing much needed technical assistance to communities which may result in substantial savings at the local level, the office should lead the state's effort to secure federal funds for conservation. President Carter recommended last June that $25 million be appropriated for direct technical assistance to states and localities for water conservation programs. In addition, agencies such as the Department of Interior and private foundations fund research projects in water conservation. Like the state's Office of Energy Policy, this office could start small but expand its budget and capabilities by securing non-state funding.

2. Leak Detection and System Rehabilitation Assistance (Appendix F)

Section II.F., above, describes the tremendous costs anticipated to rehabilitate the antiquated water system infrastructure in this state. It is clear that most municipalities cannot shoulder the burden alone, and that it is beyond even the resources of the state to provide monies at this time to meet all of the needs. It is also clear, moreover, that we must begin to address the problem now because of the increasing loss of potable water to leakage, the growing dangers to public health and safety of encrusted, undersized pipes, and the threat to economic revitalization of inadequate water systems. The question of whether we have the determination to face the problem must be confronted.

The Commission recommends that the state continue its pressure on federal officials and the Congress to make funds availble for urban infrastructure rehabilitation. The suggestion of set asides in existing urban programs is a promising possibility. To demonstrate to federal officials that the state is attempting to address the problem, and because many of these needs cannot wait for eventual federal programs, the state and the municipalities must begin the job themselves.

The Commission recommends a matching grant program for leak detection and system rehabilitation which

is modest compared to the total need. Funding through a bond issue of $10 million is recommended. Given the high level of demand, which approaches several hundred million dollars statewide, the Commission recommends that five percent of the funds appropriated be reserved for leak detection and that 95 percent be allocated for cleaning and relining or replacement of mains, repair of valves and pumps, and related distribution system upgrading. It further recommends that no single community be eligible for more than five percent of the funds available so that our limited resources can be shared equitably.

Section 1 of "An Act Providing Financial Assistance to Cities, Towns and Water Districts for the Repair and Rehabilitation of Their Water Distribution Systems" authorizes such a program. Section 2 of the act places administration of the program under the Division of Water Supply (which also administers the water purification plant assistance program) and directs the division to establish program standards and guidelines. Criteria and priorities for the receipt of funds are to be established by the Water Resources Commission and are to include the amount of unaccounted for water usage; the institution of an ongoing leak detection program; repair of leaks identified by a leak detection program; repair of distribution systems to provide adequate pressure for fire protection or to maintain public health standards. This section also calls

for communities to adopt water resource management plans pursuant to the regulations adopted by the Water Resources Commission in order to be eligible for assistance. The section also apportions the funds to leak detection and rehabilitation with a maximum eligibility for a single community as described above.

Section 3 of the act provides for repayment by any community of any federal or other non-state funds received for the same purpose which exceed forty percent of the total project costs. Thus, if sufficient federal assistance were to become available, the community's ultimate share would be ten percent of the project cost.

Section 4 provides for short term notes for the financing of the act. Section 5 provides for a $10 million bond issue to meet the obligations of the act.

The cost effectiveness of leak detection programs in Arlington and Malden is described in Section II.F. Based on their experience, a $1 million leak detection program (of which fifty percent would be state-funded) could generate savings of $8 million to $10 million per year in saved water costs. Funding needs to be available for the repair of detected leaks, of course, for savings to be realized. The other benefits of this program are more difficult to quantify. They involve increased public safety and health, reduction of water consumption which

could obviate the cost of developing new supplies, and removal of obstacles to renewed economic growth. Our water distribution systems are a vital part of the infrastructure which supports the life of our communities, and they must be maintained.

Supply Management:

3. Improved Groundwater Assessments (Appendix G)

Sections II.C. and II.E., above, stress the need for improved groundwater data to enable communities across the state to develop new groundwater supplies and to protect existing and future sources. The Water Resources Commission (WRC) deals directly with this issue and has formally requested legislation from this Commission to establish a ten-year, $5 million groundwater assessment program in cooperation with the United States Geologic Survey (USGS); fifty percent of the program would be funded by the USGS and fifty percent by the state. The WRC letter and a detailed description of the program are contained in Appendix 2. The Commission agrees with the program outlined by the WRC and recommends the following act to fund such a program.

Section 1 of "An Act Providing Increased Funding by the Commonwealth for the United States Geologic Survey Cooperative Survey Program for Groundwater Assessments and Related Hydrological Studies" declares that such a program

is necessary for the Commonwealth and that the act may be referred to as the "Groundwater Survey Act of 1979." Section 2 of the act establishes the program by amending Chapter 21 of the General Laws, which relates to the Water Resources Comission, by adding a new section 8A. The new section designates the WRC as the coordinating body for purposes of administering the program. The Commission is directed to contract with USGS to conduct a ten year program of detailed groundwater appraisals, aquifer assessments, and other geologic and hydrologic studies required to protect existing sources and to identify new groundwater sources. Subsection (b) of section 8A defines the program in greater detail and directs the Commission to establish criteria for the program which include present or recurrent water supply deficits; areas which would serve more than one community; communities whose water supply is contaminated; communities where demands are placed on the supply by state institutions; and local commitment to participation. Subsection (b) also provides for direct assistance to localities and apportions $500,000 of the total program for that purpose.

Section 3 of the act limits the program to a total of $5 million to be funded fifty percent by USGS and fifty percent by the Commonwealth. It also provides authorization for short term borrowing up to $2,500,000 to carry out the purposes of the act. Section 4 authorizes

the sale of bonds to meet the expenditures required by the act, up to $2,500,000. Section 5 provides that the act will take effect upon passage.

The long-term benefits of this program are substantial. A systematic, detailed assessment of the Commonwealth's groundwater resources will allow communities and basins or sub-basins to develop those resources in an efficient, cost-effective manner. It will also serve as an important element in local and basin water resource management plans, which are necessary to maximize the benefits of our water resource.

To the communities now facing critical supply shortages, the program will provide direct assistance to determine if viable groundwater alternatives exist. In addition, the successful development of local groundwater sources could reduce substantially the pressure for expansion of our regional surface water supplies, which inevitably involves diversions and out-of-basin transfers. Thus, the effective use of our groundwater supplies can result in more efficient and less costly supply development.

4. Increased Municipal Financing Flexibility (Appendix H)

Under section 8 of Chapter 44 of the General Laws, municipalities are permitted to go beyond their normal debt limit for a variety of public purposes, including projects related to water supply. Currently, the maximum term for such borrowing is twenty-five years for establishing or purchasing a supply system, including purchase of water rights or land for protection of a water system, and fifteen years for the rehabilitation of distribution systems, including cleaning and relining or replacement of mains, laterals and associated equipment.

Given the high costs faced by municipalities which wish to purchase private water companies in order to expand and modernize them or land to protect existing supplis, and the tremendous burden on communities which need to rehabilitate antiquated distribution systems, the Commission recommends the extension of municipal outside debt limits for these purposes to provide greater flexibility.

Section 1 of "An Act Expanding Time Limits for Which Communities May Borrow Outside Their Debt Limit for Purposes of Providing Water to Their Inhabitants" amends clause (3) of section 8 of Chapter 44 by adding the words "or private supplier" and extending the debt time limit for purchase of supplies, water rights or land to forty years.

Section 2 of the act revises clause (5) of said section, which pertains to distribution system rehabilitation projects, by extending the debt time limit to twenty-five years.

This act will not incur any obligations on the Commonwealth but will increase municipal financing flexibility for these critical water supply needs. By reducing the annual carrying costs of such debts, communities will be able to proceed on a greater number of necessary projects which might otherwise be deferred. Since the projected asset life of land, water rights and water supply systems is greater than forty years, and the projected asset life of distribution systems is greater than twenty-five years, such terms for the respective debt limits are reasonable and justifiable.

D. Recommendations to Improve State Regulations and Management Capabilities Relative to Water Supplies

Demand Management:

1. Use of Water Conserving Plumbing Fixtures (Appendix I)

One of the steps which the Commonwealth can take to reduce water consumption statewide is to promote the use of water conserving devices. The state plumbing code has recently been amended (effective November 1, 1978) to require the use of water conserving shower heads and faucet aerators. The impetus for this change was the savings in hot water and the energy required to heat it, but water consumption will be

reduced as an ancillary benefit.

The Commission believes that further steps can and should be taken to reduce consumption. Water closets account for forty percent of average residential water use and possibly more in many office and commercial buildings. Current tank type water closets found in most homes and low-rise buildings use from five to seven gallons per flush. Newer water saving models, which have been available for several years from all major suppliers, use as little as three gallons, however. In high-rise buildings where more efficient flushometer valves are used, new conserving models are available which reduce usage by up to twenty-two percent.

Water used for flushing is water unavailable for other uses. In the Metropolitan Water District communities, for example, high quality potable water is diverted from the Connecticut River basin via Quabbin Reservoir, used once, and then discharged into the ocean. To use more of this limited resource than necessary is unconscionable. The Commission recommends, therefore, modification of the state plumbing code to require the installation of water conserving water closets and urinals in all new construction and in replacement installations.

Section 1 of "An Act Requiring Water Conserving Plumbing Fixtures in Certain Buildings in the Commonwealth" accomplishes this by adding a new section to Chapter 142 of

the General Laws, which regulates the plumbing code Board of Examiners. The new section 13A calls for fixtures which comply with the following standards of use: (1) tank type water closets - maximum 3 gallons per flush; (2) flushometer water closets - maximum 3 gallons per flush; (3) flushometer urinals - maximum 1.5 gallons per flush. This section also allows the use of standard tank type water closets if they are fitted with devices (such as plastic dams) which reduce usage to the standards. Further, the Examiners may allow the use of standard, non-complying fixtures if, in their opinion, the building's drainage system requires a greater amount of water to adequately flush the system. Finally, this section directs the Board of Examiners to publish periodically a list of acceptable fixtures.

Section 2 of the act provides that it shall take effect on July 1, 1980, to provide adequate time for local suppliers to turn over their present stocks of non-complying fixtures.

This act will not place any financial burden on the Commonwealth or on any private party since water conserving fixtures are no more expensive than standard models. The potential savings are very great, however. The 1972 Curran Report on MDC Water Usage estimated domestic consumption to be 100.5 mgd in the Metropolitan Water District communities; of this, on the average 40 mgd is used for flushing water closets. If a forty percent reduction in water closet demand

were achieved (from five to three gallons per flush), 16 gpd could be saved, almost the amount by which the MDC system's safe yield is exceeded.

Such savings, of course, would take years to accomplish since only new construction and replacements would fall under the new code. Commercial and public usage would also be reduced, however, and a strong statewide conservation program could encourage a retrofit program using inexpensive toilet dams and similar devices. The net savings on community water bills could be substantial, and the need for expansion of supplies could be avoided or deferred.

Supply Management:

2. Regulation of Materials Hazardous to Water Supplies (Appendix J)

This and the next recommendation address existing state regulation of water supplies. The growing hazard to public health from contamination of drinking water, discussed above in Section II.D., has been addressed nationally by the Safe Drinking Water Act of 1974. New standards and monitoring requirements are being developed by EPA under that act but will not be in effect until at least 1980. Meanwhile, communities such as Bedford have found highly toxic contaminants in their water supplies and have been forced to shut them down.

Section 159 of Chapter 111 of the General Laws gives the Department of Environmental Quality Engineering (DEQE) the "general oversight and care of all waters" of the Commonwealth. Present regulations for monitoring and control of contaminants, however, are concerned primarily with bacteriological purity, turbidity, color and salt content. Effective approaches for detecting and controlling the numerous natural and man-made substances which are toxic have not been developed. Although certain technological advances must be made before effective control can be realized, preventative steps can be taken, particularly regarding the use and storage of substances know to be hazardous. The Commission intends by this recommendation to specifically expand the authority of DEQE to establish regulations to protect water supplies from known hazardous materials, including the regulation of use and storage of such materials.

Section 1 of "An Act Further Defining the Supervision of the Waters of the Commonwealth by the Department of Environmental Quality Engineering to Include Regulation of Materials Hazardous to Water Supplies" adds this authority to section 159 of Chapter 111 and calls for the periodic review and updating of such regulations. The list of hazardous materials to be considered includes those specified by the federal government and update periodically. Section 2 of the act provides that it shall take effect on passage.

No immediate cost is incurred by this act. Existing department personnel responsible for carrying out the provisions of section 159 of Chapter 111 should be utilized to review present regulations and recommend improved ones. In the long run, additional personnel will undoubtedly be required to enforce the regulations and to provide technical assistance to communities for monitoring and enforcement. It is hoped that the federal government will make assistance available under the Safe Drinking Water Act since this is a problem of national scope.

3. Regulation of Groundwater Contamination from Petroleum (Appendix K)

Specific authority is vested in the Division of Water Pollution Control (DWPC) for protecting and insuring clean water in the Commonwealth under section 27 of Chapter 21 of the General Laws. This recommendation adds the term "underground waters" to this statute to insure that the division's research and evaluation functions will include all of the state's water resource.

No classification of groundwater quality has been established to date, and groundwater policy is completely lacking. This is a result, in part, from the emphasis of federal water quality programs which have focused on surface water and ignored groundwater. As the nation and this state become increasingly aware of the need for conjunctive

management of surface and ground waters, however, this narrow focus must be changed.

A particularly pressing need for groundwater management emanates from the growing hazard from underground gasoline storage. Current state standards applied to storage tanks relate to public safety and fire hazard, but not to potential contamination of water supplies. Standards for storage tank siting and inspection must be established to avoid costly experiences such as that suffered by Provincetown, discussed earlier in section II.D.

Sections 1 and 2 of "An Act Further Defining the Duties and Responsibilities of the Division of Water Pollution Control to Include Groundwater Contamination" add the term "underground waters" to the fourth and eighth paragraphs of section 27 of Chapter 21, as noted above. Section 3 further amends this section by adding the word "petroleum" to the definition of "oil" in paragraph (14), which provides for the control of oil spills and contamination.

As with the previous act, no new costs are incurred by this act immediately. Technical assistance to local communities to help them regulate and inspect underground oil and gasoline storage facilities and to combat leakage, however, may require additional personnel, once new regulations are established. The development of such new regulations and standards by DEQE and DWPC is the first essential step in addressing this growing hazard.

Administrative Management:

4. Drought Contingency Planning (Appendix L)

Effective responses to droughts are difficult to implement and require advance planning and preparation. Measures to reduce consumption can include rate increases, bans on non-essential uses, per capita consumption limits, recycling and reuse, among others. Many Massachusetts communities have used and continue to use one or more of these measures as a response to seasonal shortages.

The provision of additional supplies in times of shortages can involve emergency pipelines or hook ups to adjacent communities, as has been done in Amherst, Bedford and Provincetown this year; the hauling of emergency water supplies, as Gloucester was forced to do this summer; or the development of new sources. Without a proper watershed area, however, new impoundments do not provide a solution; and without adequate supplies of groundwater, drilling new wells will not be a successful alternative. In addition, a severe drought will reduce the potential of alternative supplies just as it reduces the yield of present supplies.

Unfortunately, the impetus to plan for droughts seems to disappear as soon as the shortage is over. The major statewide drought of the early sixties should have been convincing proof of the need for contingency planning; yet as soon as it was replaced by a decade of wet years, the need

was forgotten. Similarly, individual communities such as Amherst and Stoughton have faced severe shortages before, but as soon as they ended they were forgotten by most people.

The necessity for drought contingency planning has increased as the demands on our water supplies have grown. The Massachusetts Water Supply Policy Statement projects shortages for 155 communities by 1990. Recurrence of a drought like that of the sixties could make those shortages a reality much sooner.

The Commission recommends that the reponsibility for drought contingency planning be specifically added to the duties of the Water Resources Commission, the one state agency charged with overseeing all water-related issues in the state. The WRC should provide leadership in coordinating the roles of all state agencies which deal with emergency preparedness. It should also encourage drought contingency planning at the local and basin levels, where solutions most commonly will be found. Already the WRC has called for such planning as part of local water resource management plans (see WRC regulations, Appendix 3.)

Section 1 of "An Act Further Defining the Powers and Duties of the Water Resources Commission to Include Drought Contingency Planning" adds the words "drought contingency planning" to the second, third and fourth sentences of the first paragraph of section 9, Chapter 21 of the

General Laws, which specifies the duties and responsibilities of the WRC. Section 2 of the act states that the remaining paragraphs of this section remain unchanged. Section 3 provides that the act shall take effect on passage.

To the extent that existing resources are utilized for statewide water resources planning, this additional responsibility will not require any new expenditures. It is simply an important aspect of such planning. The fact remains, however, that this kind of comprehensive planning does not now occur. The last recommendation in this section addresses that problem and poses a solution.

5. Local Water Resource Management Plans (Appendix M)

The need for comprehensive water resource management plans at both state and local levels to insure the wise use and development of this limited resource has been documented throughout this report. Although such planning is a relatively new concept in Massachusetts, the Water Resources Commission (WRC) has taken the lead in encouraging such planning. Under regulations recently adopted by the WRC, basin and statewide plans will be the responsibility of that agency, and local plans, while not mandatory, are encouraged. (See WRC regulations, Appendix 3.)

The Special Legislative Commission believes that such plans should be a condition for the receipt of state

assistance for all water-related projects. The adoption of such plans will help to insure that the investment of limited state resources is done in the most effective manner. Such a requirement is also consistent with developing federal requirements for comprehensive planning and conservation as a condition of eligibility for receipt of federal funds.

Section 1 of "An Act Concerning Local Water Resource Management Plans for State Funding of Water Projects" amends Chapter 21 of the General Laws, which defines the responsibilities of the WRC, by adding a new section 11B. This new section provides that towns or cities eligible for state assistance for water projects including water or sewer works, development of water supplies, flood control, or any other water program within the Executive Office of Environmental Affairs, shall have adopted or be in the process of adopting a comprehensive water resource management plan. The section further provides that the WRC shall be responsible for certifying such compliance to the appropriate funding agency. Section 2 of the act provides that it shall take effect on passage.

The burden on local communities of complying with this provision will not be substantial. The regulations adopted by the WRC provide great latitude to communities regarding the content of the plans and the level of detail required. The information for such plans already exists in most communities and simply must be organized in a coherent

manner. In addition, the WRC intends to provide technical assistance for plan preparation to those communities requesting it. This assistance will be funded under Title III of the Water Resources Planning Act of 1965, for which President Carter has recommended substantial increases.

As noted previously, comprehensive water resource planning is required if limited state and local funds are to be used in the most cost-effective way. Since substantial amounts of money are involved in many water-related projects, the expenditure of additional efforts to plan for the wise use of this money is a sensible and needed management approach.

6. Establishment of a Division of Water Resources planning and Technical Assistance (Appendix N)

The final recommendation of the Commission addresses the need for the Commonwealth to develop an integrated, systematic approach to comprehensive water resource planning. Section II.G. of this report described the fragmentation and compartmentalization that has developed over the years in the state agencies which deal with water resource issues. As an increasing number of federal water programs are delegated to the state to administer, the need for a systematic approach becomes more critical.

Fortunately, the opportunity for developing this needed capacity presently exists. Current levels of funding

and personnel are adequate to accomplish the task. What is needed is a restructuring to bring all the current water planning functions and skills together under coordinated direction.

The Commission recommends that a new division be established for this purpose under the guidance of the Water Resources Commission (WRC). Section 1 of "An Act Establishing a Division of Water Resources Planning and Technical Assistance" creates this division by adding a new section 8B to Chapter 21 of the General Laws, which deals with the WRC. The new division would be responsible for comprehensive basin and statewide water resources planning; the direction and coordination of all cooperative water and related land resources data programs, such as those conducted by the U.S. Geological Survey and the Soil Conservation Service; the provision of technical assistance to communities and regions for water resource management needs; the direction of a lakes management program; and the development of a comprehensive data management program to provide uniform, comprehensive water resources data to other state agencies and localities.

Section 2 of the act provides that it shall take effect on passage.

The creation of this coordinated water resources planning division can be accomplished without any new state

expenditures. Currently funded federal programs already provide for a variety of planning and data management functions. EPA, U.S. Geological Survey, and the Soil Conservation Service are among the agencies which provide funds for these purposes.

Authorization of such a division by the General Court is the first step required. Many of the planning and data functions now under the Executive Office of Environmental Affairs could then be shifted administratively. The Secretary of EOEA and the various department heads should make the decisions as to which functions to include, since the new division will be under their direction through the Water Resources Commission and will serve important planning and data functions for each department. If further legislative changes are required to complete the division, recommendations for these should come from EOEA following the initial restructuring.

The cost of not providing an integrated, systematic approach to water resources planning at the state level will be the continuation of the present fragmented, ineffective system. While the cost of lost opportunities is difficult to calculate, a number of examples illustrate the problem.

In early 1978, the Commonwealth received $11,800 from FY 1977 federal funds to begin work on a water use

data program as part of a national effort under U.S.G.S. Another $25,000 was made available in FY 1979. U.S.G.S. has requested $30,000 for FY 1980 for this program, and recently announced the possibility of an additional $20,000 for the same purpose. Because the Commonwealth lacks a coordinated agency to develop this needed data program and the Division of Water Resources lacks appropriate personnel, none of these funds have been spent. Yet a computer with more than adequate unused capacity is available in the Division of Water Pollution Control.

Another example lies in the current approach to basin planning. The U.S.G.S. engages in studies of basin hydrologic resources, but this program has been severely curtailed by the lack of state matching funds. In addition, the Division of Water Pollution Control performs basin planning functions for purposes of the Federal Water Pollution Control Act, but its planning focuses only on surface water quality issues and does not consider groundwater. Finally, the Soil Conservation Service has just proposed a $300,000 per year basin planning program for Massachusetts under its watershed management program, but as yet there is no mechanism for coordinating it with other state programs and priorities.

The Special Legislative Commission believes that the centralized direction of these and related programs could eliminate duplication, insure consistency of data

produced, improve availability of data for both local communities and state agencies, and provide the most cost-effective approach. Creation of the proposed Division of Water Resources Planning and Technical Assistance will result both in savings and in the provision of better, more comprehensive water resources planning.

IV. ON-GOING WORK OF THE COMMISSION

A. Issues Requiring Further Study

The range of issues related to the continued adequacy of water supplies in the Commonwealth is extremely diverse, as this report has indicated. Investigations have been initiated on a number of critical issues which, due to their complexity and the limitations of time, could not be concluded. These issues include:

1. Legal Redefinition of Groundwater Law

Section II.E. of this report described the need for a major study and redefinition of groundwater law in Massachusetts. A commendable beginning was made in the report of the Water Resources Commission to the General Court pursuant to Chapter 111 of the Resolves of 1973, titled "Groundwater and Groundwater Law in Massachusetts." The recommendations of that study need to be reviewed and updated and then translated into legislative recommendations. Because of the legal complexity of this issue, and of the following topic, a substantial legal effort will be required.

2. Development of Allocation Mechanisms

The recognition that the ground and surface waters of a watershed are part of a single hydrologic unit leads to the inevitable conclusion that the use of one affects the availability of the other. Allocation of water

rights in the Commonwealth historically has been accomplished through Special Acts of the Legislature as needs have arisen but in the absence of comprehensive basin plans which provide for conjunctive management of both ground and surface waters.

Prior allocations of water, particularly in basins under stress, need to be reviewed for possible revision of unexercised rights. In addition, more rational mechanisms must be developed to deal with future allocations of both ground and surface water within the context of a comprehensive water resources management system.

3. Development of Comprehensive Planning Capability

The recommendation of the Commission for establishment of a Division of Water Resources Planning and Technical Assistance is the first step towards this goal. A substantial effort will be required, however, to carry out the needed restructuring of existing planning functions, and legislative input will be an essential ingrediant in that process.

In addition, local water resource planning and management must be developed to enable localities to carry out their local water supply responsibilities. Basin-level planning mechanisms currently do not exist but may have to be created.

4. The Role of Water in Economic Development

One of the critical issues facing Massachusetts is continued economic development which is consistent with state policies on growth and environmental protection. A vital ingrediant of all economic growth is adequacy of water supplies. The Commonwealth has an abundant water resource which, if properly utilized, can provide an incentive for the growth of water-dependent industries and businesses.

The Commission believes that the economic development policies and strategies of the Commonwealth must be coordinated with water resource policies which maximize the benefits of both.

5. Quality Issues

Section II.D. of this report indicated the growing problems and threats to continued water supply quality in the Commonwealth. Improvement of existing supplies and the protection of future supplies must continue to be a high priority of the state and local communities. The issues of how to protect against potential contaminants and how to monitor supplies to determine their presence requires further study and legislative action, for local communities do not have the resources or skills to adequately address all of the problems.

6. Interstate Issues

The major interstate issue facing the Commonwealth has been until recently the proposed diversion of the Connecticut River to supplement the supplies of the Metropolitan District Commission. This legal issue of riparian rights in the Connecticut River valley will be addressed in the Environmental Impact Review just begun on the Northfield Diversion project. If any interstate agreement between Massachusetts and Connecticut is reached regarding the use of Connecticut River waters, a compact will have to be developed through legislative action.

A second major interstate issue which is developing concerns the Merrimack River. Potential diversions in New Hampshire would have substantial deleterious effects on water quantity and quality downstream in Massachusetts. Members of the New Hampshire Legislature have already indicated a desire to meet with this Commission to discuss possible interstate approaches to managing the Merrimack River. Such a cooperative approach should be pursued now before a crisis develops.

B. Commission Organization

In order to better address the issues outline above, the Commission has decided to develop a subcommittee structure which would encourage participation of a wide range

of interested groups and parties in each of these areas. Such a structure would also better focus the work of the Commission and its members.

The Subcommittee on Water Resource Management Issues would address the questions of water law revision, allocation mechanisms, development of a comprehesive planning structure and capability within the state, and the development of a State/EPA agreement covering the state's approach to administration of federal water programs.

The Subcommittee on Water Supply and Economic Development would examine growth and economic development policies and investigate water resource policies which would be consistent with and reinforce them. Recycling and reuse in industry, rehabilitation needs, and identification of appropriate industries for water-rich and water-deficient areas would be among the topics of its concern.

The Subcommittee on Water Supply Quality would continue the investigations of the Commission into monitoring needs; the implications of developing requirements under the Safe Drinking Water Act; mechanisms for protection of present and future supplies from natural and man-made contaminants, including salt, chemical wastes, landfills and urban development; and the need for improving existing supplies.

Finally, the Subcommittee on Interstate Water Issues would initiate a dialog with New Hampshire and Connecticut legislators to explore the possibility of interstate compacts to deal with the growing range of interstate issues in the Merrimack and Connecticut River valleys. In addition, this subcommittee should explore potential issues involving Massachusetts and Rhode Island which might arise in the Blackstone and other joint watersheds.

C. Recommended Continuing Resolution (Appendix O)

A recommended "Resolve Reviving, Continuing and Increasing the Scope of the Special Commission Established to Make an Investigation and Study Relative to the Adequacy of Water Supply in the Commonwealth" is contained at the end of this report. In addition to continuing the work of the Commission, it expands the scope of its study to specifically include a review of all legislative allocations of water rights, development of recommendations for allocation mechanisms for both ground and surface water, and recommendations for redefinition of groundwater law which may be necessary to implement such mechanisms.

The Resolve directs the Commission to report to the General Court not later than the fourth Wednesday of December 1979.

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THE COMMONWEALTH OF MASSACHUSETTS

In The Year One Thousand Nine Hundred And Seventy-Eight

RESOLUTIONS ON WATER CONSERVATION.

Whereas, The water resources of the commonwealth are essential to the public health and economic welfare of its citizens; and

Whereas, The supply of water in the commonwealth is a finite resource and should be regarded as such; and

Whereas, The increasing demands on the commonwealth's water resources for drinking supplies, waste assimilation, recreation, power generation, industrial processing, cooling water, agricultural use and aesthetic enjoyment and often conflict with one another; and

Whereas, These increasing demands, without more efficient use of water, have grave implications regarding the cost of water supply and treatment; and

Whereas, The President of the United States has identified water conservation as a new national policy and called for state water resource planning to integrate water management and implementation programs which emphasize water conservation; and

Whereas, The special legislative commission on the adequacy of water supply in the commonwealth endorses the national policy of water conservation and recognizes that additional benefits of saving labor, land, energy, and capital can be realized by implementing water conservation methods; now therefore, be it

Resolved, That it be the opinion of the Massachusetts General Court that the commonwealth actively seek support from all levels of government, and the public, to work together to develop, implement and finance water conservation programs as the cornerstone of a consistent, coordinated statewide water supply policy; and be it further

Resolved, That considerations of water quality, environmental impacts, economic and equitable concerns, and state land use policy be integrated systematically into the overall water resource policy of the commonwealth.

House of Representatives, adopted, June 27, 1978.

Thomas W. McGee
SPEAKER OF THE HOUSE

Wallace C. Mills
CLERK OF THE HOUSE

Senate, adopted in concurrence, June 27, 1978.

[illegible] B. [illegible]
PRESIDENT OF THE SENATE

Edward B. O'Neill
CLERK OF THE SENATE

Offered by:

REPRESENTATIVE JOHN F. CUSACK
REPRESENTATIVE RAYMOND A. JORDAN, JR.
REPRESENTATIVE BERNARD D. FLYNN
REPRESENTATIVE PETER L. McDOWELL
REPRESENTATIVE ANDREW J. ROGERS, JR.
SENATOR CAROL C. AMICK
SENATOR JOHN W. OLVER
SENATOR WILLIAM L. SALTONSTALL

THE COMMONWEALTH OF MASSACHUSETTS

In The Year One Thousand Nine Hundred And Seventy-Eight

RESOLUTIONS ON MAJOR WATER SUPPLY AUGMENTATION PROJECTS.

Whereas, The need for the completion and implementation of a comprehensive and definitive statewide water supply policy led to the formation of the special legislative commission on the adequacy of water supply in the commonwealth for the purpose of establishing such a policy; and

Whereas, The need for water conservation has been recognized as both a state and a national priority; and

Whereas, The full range of economic and environmental effects of major water supply augmentation projects must be considered in order to achieve a balance between water use and resource conservation; now therefore be it

Resolved, That it be the opinion of the Massachusetts General Court decisions on major water supply augmentation projects shall be deferred pending completion of the review of state water supply policy by the special legislative commission on the adequacy of water supply in the commonwealth; and be it further

Resolved, That interbasin transfers, including the proposed Northfield mountain diversion of Connecticut river waters to Quabbin reservoir, for the purpose of augmenting the water supply of the metropolitan water district, shall be considered alternatives of the last resort. All feasible water supply alternatives, including conservation programs in the receiver area and development of local supplies, shall be identified and evaluated within the context of the commonwealth's developing statewide water supply policy; and be it further

Resolved, That the United States Army Corps of Engineers be advised that the proposed Northfield mountain diversion shall be designated as a low priority project.

House of Representatives, adopted, June 27, 1978.

Thomas W. McGee
SPEAKER OF THE HOUSE

Wallace C. Mills
CLERK OF THE HOUSE

Senate, adopted in concurrence, June 27, 1978.

Henri B. Hamilton
PRESIDENT OF THE SENATE

Edward B. O'Neill
CLERK OF THE SENATE

Offered by:

REPRESENTATIVE JOHN F. CUSACK
REPRESENTATIVE RAYMOND A. JORDAN, JR.
REPRESENTATIVE BERNARD D. FLYNN
REPRESENTATIVE PETER L. McDOWELL
REPRESENTATIVE ANDREW J. ROGERS, JR.
SENATOR CAROL C. AMICK
SENATOR JOHN W. OLVER
SENATOR WILLIAM L. SALTONSTALL

APPENDIX 2.

LEGISLATIVE RECOMMENDATIONS FROM OTHER GOVERNMENTAL BODIES

a. Recommendations of the Special Commission Relative to the Effect of Present Growth Patterns on the Quality of Life in the Commonwealth: Letter of June 28, 1978, and copy of recommendations contained in City and Town Centers: A Program for Growth, a 1977 report by the Office of State Planning.

b. Recommendations of the Water Resources Commission: Letter of November 15, 1978, and an "Overview - Water Resources Commission Detailed Basin Assessment Program with the U.S. Geological Survey."

The Commonwealth of Massachusetts

SPECIAL COMMISSION ON THE EFFECTS OF
GROWTH PATTERNS
ON THE QUALITY OF LIFE IN THE COMMONWEALTH
Created by Chapter 98 of the Resolves of 1973
STATE HOUSE, BOSTON, MASSACHUSETTS 02133

APPENDIX 4.

June 28, 1978

Senator Carol Amick and
Representative John Cusack, *Chairpersons*
The Special Commission on the Adequacy of the
Water Supply of the Commonwealth
State House
Boston, Mass. 02133

Dear Commission Members:

The Special Commission on the Effects of Growth on the Quality of Life in the Commonwealth has recently completed our effort to generate state policies relative to future growth and development in Massachusetts which respond to the expressed consensus of local and regional bodies throughout the state. This process, which involved the active participation of over 5,000 members of specially-convened Local Growth Policy Committees in 330 of the state's 351 cities and towns, the state's thirteen regional planning commissions and the Office of State Planning, has resulted in formulation of a general statewide consensus on a broad range of growth related issues, including the issues of water supply and quality.

In response to the elements of consensus relating to water supply, the Office of State Planning, in its 1977 report entitled, *City and Town Centers: A Program for Growth,* proposed four specific "action recommendations". Each of these recommendations generated considerable public comment in a series of seven Commission hearings

convened throughout the state to solicit local reaction to the Office of State Planning report. We, therefore, respectfully request that the Special Water Study Commission carefully consider the following Office of State Planning proposals: (these recommendations can be found on pages 76 and 77 of the OSP's *City and Town Centers: A Program for Growth).*

1. *Continue implementation of the statewide water conservation program.* Several water conservation measures recently inaugurated by the Executive Office of Environmental Affairs were seen by the hearing participants to be a good first step toward reducing waste and unnecessary use of the state's water resources. We suggest that the possibilities of extending and expanding this effort should be actively investigated.

2. *Encourage water supply self-sufficiency.* The premise underlying this recommendation is that inter-basin and long intra-basin transfers of water are undesirable and should be used to supply local drinking water only after all other alternatives have been exhausted. The use of local, nearby water supplies by a community, however, requires the funding and technical capability to conduct thorough surveys of water supply potential. It also requires effective regulatory mechanisms to preserve and protect identified supply sites. In recognition of these factors, the Office of State Planning has proposed a system of state-funded water search grants to localities which would be contingent on local agreement to use and protect the supplies identified during the search. We commend this suggestion to your attention and request that the Special Water Study Commission cooperate with the Special Commission on the Effects of Growth in the consideration of the growth impacts of any water search program as well as any proposed inter-basin transfers.

3. *Provide state intervention into local water supply decisions as a "last resort".* This recommendation received a mixed reaction from the participants at our hearings, stemming in part from some confusion regarding its meaning and implications. We therefore request that the question of state involvement in local water supply decisions be given careful evaluation in your review of the appropriate role of local, regional and state water authorities.

4. *Apply a total systems approach to water resources.* The Office of State Planning recommended a number of specific actions to improve

the coordination of water-related decision-making in the Commonwealth. One of these proposals calls for a reorganization and consolidation of the state agencies currently responsible for separate aspects of water resource management. This idea was well received at our hearings and we suggest that the Water Study Commission consider it as an important first step for state government to take in its formulation of a comprehensive set of state water policies.

Secondly, an amendment to the federal Clean Water Act was called for which would permit the integrated consideration of water supply and waste water treatment problems. We endorse this recommendation and commend it to your attention.

The Special Commission on the Effects of Growth feels that these proposals, if implemented, could significantly enhance the adequacy of the state's water quality and supply. The Growth Policy Commission is committed to the further consideration and action on the recommendations outlined above. We look forward to working with you in translating these initiatives into legislation for consideration by the General Court.

Sincerely,

THE SPECIAL COMMISSION ON THE
EFFECTS OF GROWTH ON THE QUALITY OF
LIFE IN THE COMMONWEALTH.

Water

After two years of public participation and intensive study, the Executive Office of Environmental Affairs has produced a report entitled the Massachusetts Water Supply Study which recommends strategies to preserve our water resources. Some of the more significant strategies are:

- ☐ that the state embark on a major water conservation program;
- ☐ that each city and town develop its own plan for water supply;
- ☐ that the state or federal government determine the minimum stream flow requirements which will assure the ecological integrity of tapped rivers;
- ☐ that repair and maintenance of existing water distribution systems be encouraged; and
- ☐ that all state agencies responsible for water supply be consolidated under a strengthened Water Resources Commission.

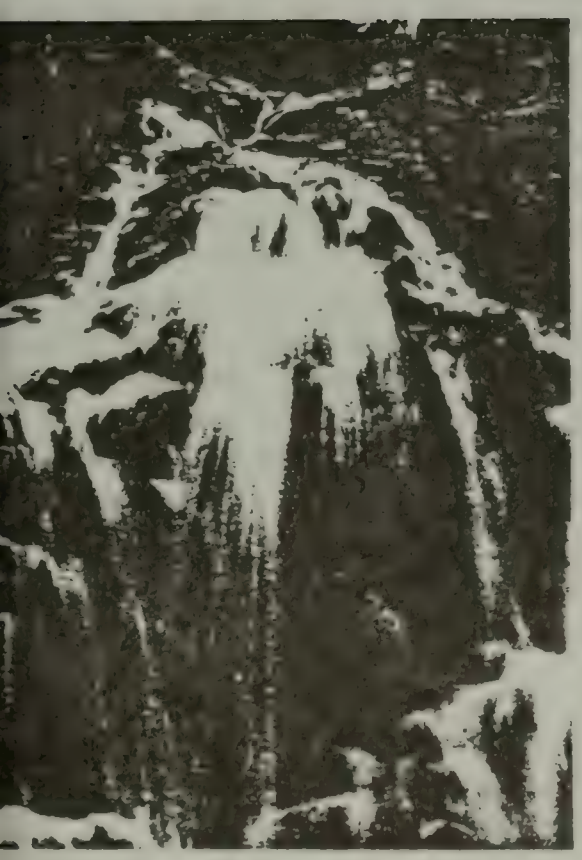
Building upon these strategies, the Commonwealth should take the following steps to ensure high quality and adequate quantity of present and future water supplies.

The following recommendations are made:

22

Continue implementation of the statewide water conservation program.

Through the Executive Office of Environmental Affairs, state government has recently begun to develop and implement a statewide water conservation program. First, consideration should be given to repair and maintenance of the existing distribution system to avoid waste. Second, more efficient use of water through metering, industrial recycling, and the use of residential water-saving devices should be sought. To make these conservation measures effective, it may be necessary to increase the water costs and replace discount rates for large volume users with progressively higher costs for higher usage. Combining these methods with the expanded use of surface waters now being improved under the federal water quality program and with the intensified search for groundwater, should reduce water shortages in many communities.



Equally important is public education to increase awareness that Massachusetts has significant water problems and that actions can and should be taken to decrease waste and increase judicious use. EOEA is taking steps to accomplish this. Also, state laws and regulations should be modified to promote water conservation. To date the State Environmental Code has been revised to permit waterless toilets with local board of health approval, and amendments to the State Building Code are being considered which would make plumbing codes more amenable to water conservation.

23

Encourage water supply self-sufficiency.

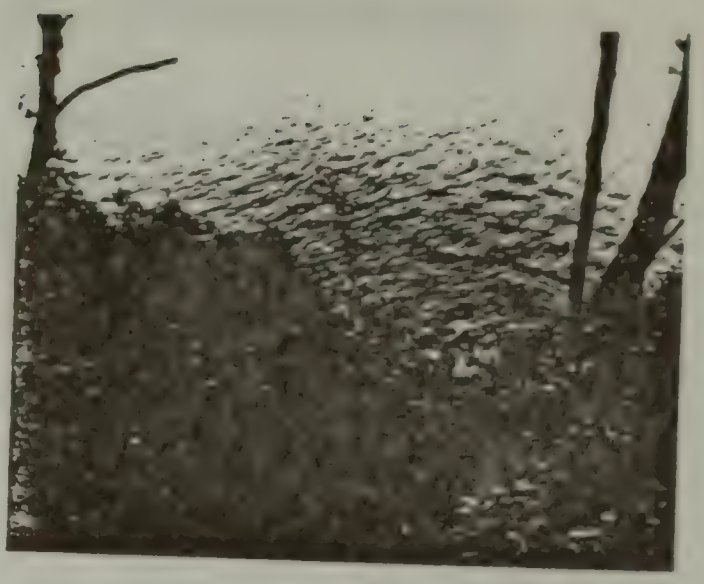
Local water supply plans should include an exhaustive search, both within the community and in adjacent communities, for additional supplies. This search could be partially funded by the state or aided by state technical resources.

The conditions for the award of state water search grants or technical assistance would be the community's agreement to use all discovered and existing supplies to the fullest degree possible, to conserve unneeded resources, and to preserve potential supply areas from development.

24

Provide state intervention as a "last resort."

e state, the only source for water supply funding other than locally generated enues, should show flexibility and sensitivity to different water problems. In those es where there is a proven need for more water and local supplies are inadequate the economics are unreasonable, the state as a last resort should intervene and vide the appropriate facilities. If the state intervenes, issues relating to basin-wide well as local water needs and to growth implications must be considered. The state uld avoid inter-basin transfers, such as the transfer of Connecticut River water to Quabbin system. Thus, the MDC should continue its present policy of caution in sidering expansion to serve the water needs of new communities. Only after all rnatives are fully investigated, conservation measures utilized, and all feasible rnatives employed should exceptions be made.



25

Apply a total systems approach to water resources.

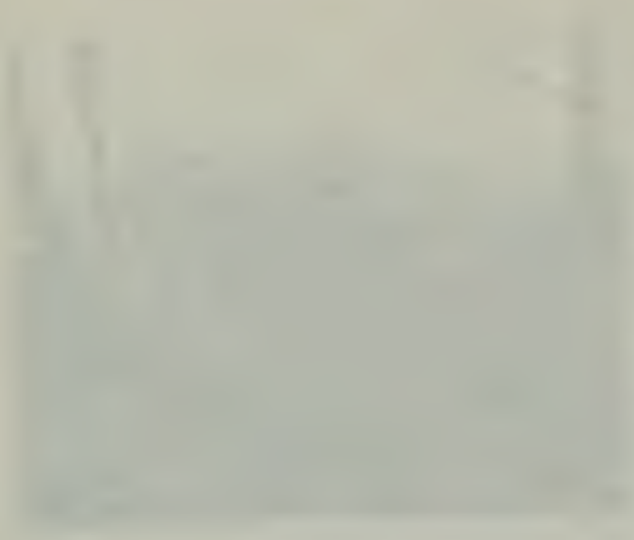
rtunately, there is very little federal money to aid local and state initiated water ervation efforts. On the other hand, vast sums have been spent by the federal rnment on water pollution control facilities and planning. There is a pronounced , both at the federal and state levels, to adopt a total systems approach to water rces in which decisions on waste water treatment and water supply are fully rated. A broad-based water conservation program could mean significant ctions in waste water, which would reduce the need for more and larger ment facilities and the incidence of septic tank failures that often mean sewer ex- ons into areas where they are not wanted.

State government should take all necessary steps to consolidate state agencies nsible for water supply and waste water treatment under one coordinated ad- trative structure. Furthermore, the state Clean Waters Act should be amended vide funding for water purification plants.

At the federal level, the Massachusetts Congressional delegation should file tion for an Omnibus Clean Waters Act which would address both water supply vaste water treatment problems in an integrated, coordinated manner. Such tion would provide funding for water supply planning and conservation ams and establish a construction fund for public water purification and distribu- ystems and, especially important for older cities, the rehabilitation of existing ution systems.

"On the positive side, the growth of the town has given it new life. There has been an increase in interest and participation in local affairs among newer residents. Those new residents who have put down roots in the community have brought a new perspective to the conduct of town affairs."

Milford Growth Policy Statement



The Commonwealth of Massachusetts
Water Resources Commission
Leverett Saltonstall Building, Government Center
100 Cambridge Street, Boston 02202

OFFICE OF THE DIRECTOR
DIVISION OF WATER RESOURCES

November 15, 1978

Senator Carol Amick
Representative John Cusack
Special Legislative Commission to
Study the Water Supply of the
Commonwealth
14 Beacon Street
Boston, Massachusetts

Dear Senator Amick and Representative Cusack:

Several months ago the Water Resources Commission established an inter-agency task team to define major water resource concerns. The Commission has determined that several of the suggestions made by the task team require legislative action. The Commission therefore voted to make the following recommendations for consideration to the Special Legislative Commission to Study the Water Supply of the Commonwealth.

1. Request for a $5 million bond issue to enter into a cooperative agreement with the U.S. Geological Survey, on a 50-50 cost shared arrangement, to assess the aquifers of Massachusetts and their yields. Ground water is an important source of water for many Massachusetts communities. As members of your committee know, the pollution of ground water sources has been a major problem in many communities. By more precisely identifying the location of ground water resources, municipalities and the state itself would be in a better position to effectively manage this resource.

   The Commission is recommending an approach by bonding because the program would take several years to implement. It would rely on the technical capabilities of the U.S. Geological Survey. If the U.S.G.S. is to respond it will take some time to build a technical staff for implementation. In order to build that staff, U.S.G.S. will need some assurance that there is a commitment to support a program of sufficient duration to justify this initial investment.

The Commission would be most willing to develop a detailed assessment of the scope and costs of a program if it would be useful to your efforts.

2. The relationship between ground water withdrawals and effects on surface water systems needs to be recognized in law. There are some river systems such as the Ipswich, where ground water withdrawals have significant impact on the river's flow and down stream rights granted by the legislature. We would like to suggest that the Legislative Commission assess ground water law in Massachusetts and management systems based on known hydrologic characteristics of ground water.

3. The current system for allocating ground and surface water needs to be reassessed. In some cases, problems of over allocated river systems are only surfaced when a crisis occurs. The Commission believes that a thorough review of current practices should be undertaken and alternative approaches be devised.

   Although some studies have suggested the need for a river basin water allocation authority, we are not suggesting a shift in authorities or additional regulations, but rather a thorough study of the problem. Solutions may not be as complicated as a river basin authority. For example, many problems might be eliminated by an adequate river basin planning activity. We would suggest that an element of the review process might be an assessment of current allocation authorization.

We hope you will consider the foregoing suggestions in your legislative recommendations and plan of work for 1979. The Water Resources Commission stands ready to support your work in any way it can.

Richard E. Kendall, Co-Chairman
Water Resources Commission

David Standley, Co-Chairman
Water Resources Commission

OVERVIEW

WATER RESOURCES COMMISSION DETAILED BASIN ASSESSMENT PROGRAM WITH THE U.S. GEOLOGICAL SURVEY

INTRODUCTION

The Massachusetts Water Resources Commission in cooperation with the U.S. Geological Survey has conducted a continuing water resources study program which includes the assessment and documentation of ground and surface water favorability. From time to time reports of several Massachusetts Hydrological areas have been published in what is termed the Hydrological Atlas Series. Although these reconnaissance studies provide valuable information on the location of ground-water sources, quantification of yield to allow local and state assessments of ground water potential and the impact of water withdrawals is insufficient.

In 1973 the Legislature directed that a study be conducted by the Water Resources Commission of ground-water and ground-water law in Massachusetts (Chapter 111 of the resolves of 1973). The resulting report stressed the interaction and inseperability of surface and ground water and presented major cases of technical and legal issues involved in ground-water supply, the pollution of ground-water resources, out-of basin transfers, salt-water intrusion, and the impacts of development on pond levels and stream flow. Since the preparation of that report more and more Massachusetts communities have experienced serious public water supply quality problems. Ground-water sources have been, and will continue to be a major source of supply for many Massachusetts communities. With increasing pressure for the development and protection of ground-water supplies there is a need to identify more precisely

basin hydrology, location of ground-water supply, the capacity of each aquifer system, and what will happen as water sources are tapped.

The Water Resources Commission proposes that as the Atlas Program nears completion, the next phase of study in the continuing productive USGS/WRC cooperative program be to perform quantitative analyses of aquifers and related surface waters within the state. That program is outlined below.

SCOPE OF STUDIES

Two major interconnected activities would be undertaken:

1.) Detailed basin assessments

2.) Special Investigations

DETAILED BASIN ASSESSMENTS

Detailed studies would focus on quantitative analysis of aquifers and related stream hydrology. The scope of a particular study may vary from significant aquifers of limited aeriel extent to entire basins, depending upon current and forecasted water problems. In addition to assessments of ground-water yields based on aquifer characteristics, boundary conditions, and recharge, the work plan for a particular basin or aquifer could include as assessment of the relationship between ground and surface waters. As appropriate to the problems of a particular basin, surface water flows could be analyzed for various flow conditions.

There are some hydrologic systems currently under less stress which are expected to remain relatively stable for the foreseeable future. There have already been detailed studies for aquifer areas (ie., Cape Cod, Parker). It is not likely that every aquifer in Massachusetts will be

studies in detail. The proposed goal will be to complete detailed studies for some 20 basins of 26 basins defined for planning purposes.

Major geographical areas in Massachusetts have experienced ground water problems - western Massachusetts, Plymouth County and the Cape Cod area. There will be a need to determine the relative importance of various study areas. The criteria that would be used to determine funding priority would be:

A.) Existing and projected supply deficit

B.) Need to resolve competetive use,stream flow or pond level depletion

C.) Specific problems such as degradation of supply, salt water intrusion or well interference

D.) Availability of data

E.) Indication of local and regional support (including financial) to use the data developed to manage local resources.

The work involved would require for each basin studied a minimum of once professional hydrologist and assistant and drilling capability. The detailed technical work, including technical personnel, would be performed by the U.S. Geological Survey. The Commonwealth would set priorities and share on a 50-50 basis the cost of the work of the Geological Survey. The results would be a quantitative assessment of aquifer yields, the effects of various withdrawals on the aquifer and the related surface-water systems.

The proposed program would utilize federal assistance and personnel with demonstrated competence in the field. It would allow a phased build-up of the U.S.G.S. technical staff needed in the Massachusetts program. FY 1980 start up and program design and organization. During

FY 1981 the first basin assessment would begin, while FY 1982 would see the completion of one aquifer assessment and the start of two and FY 1983 would see the completion of two assessments. Thereafter three basin starts and three basin completions would be programmed each year until all appropriate areas were studied.

The cost of a two year program for each river basin is estimated to be $150,000 to $200,000. The cost will vary depending upon size of the area to be studied, data available, and need to do field drilling. Field drilling is a major variable cost. A figure of $200,000 per basin is used to account for inflationary impacts over the period of the plan. A contingency of $300,000 is provided for potential additional drilling costs. Twenty basins at $200,000 each is a cost of $4 million plus drilling contingency of $300,000. Fifty percent of that cost would be absorbed by the U.S. Geological Survey, leaving a net cost of $2,150,000 for Massachusetts.

The information derived from the program would be used by local, regional and state officials in making decisions on the management of water resources. There will be a need to provide a level of technical expertise to analyze data available and make specific recommendations to the appropriate management agency. Examples of the type of analysis would be the hydrologic impacts of the study at a hazardous waste disposal site or impact of developing wells on adjacent surface water systems. The proposed basin assessment program would include a estimated $200,000 for such analysis. This cost would be shared with U.S.G.S. for a net cost to the Commonwealth of $100,000.

SPECIAL INVESTIGATIONS

Many ground water problems in Massachusetts involve aquifers of less than regional scale. There are many examples of communities competing for ground-water resources. Interstate problems are occuring more frequently (eg., North Attleboro/Pawtucket or Salisbury/Seabrook). There is a need to provide detailed technical assistance to meet unforeseen needs of local communities which have ground-water problems on a very selective basis to assess, judge and make decisions regarding ground-water conflicts.

The second portion of this proposal is for $250,000 to assist local communities. The Water Resources Commission would act as a focal point for communities or regional entities in arranging with the U.S. Geological Survey to provide hydrologic data and technical interpretation to assist the local communities in identifying solutions to these problems. The U.S. Geological Survey can enter cooperative programs on a 50-50 matching basis with the Water Resources Commission if federal matching funds are available. The scope of the problems are usually local in nature, and involve more than one community. Chapter 21, Section 9 provides two or more communities may request special studies and provide 50% of the non-federal funds. The proposed program would further expand this option by local communities paying half of the non-federal share of these special studies and the Commonwealth, through the Water Resources Commission, paying the other half of the non-federal share.

The Commonwealth should also make a commitment to encourage communities to seek the technical information needed to make rational decisions.

APPENDIX 3.

WATER RESOURCE MANAGEMENT PLANNING REGULATIONS

(313 CMR 2.00; adopted by the Water Resources Commission December 11, 1978.)

313 CMR: WATER RESOURCES COMMISSION

313 CMR is amended by adding the following chapter:

313 CMR 2.00: WATER RESOURCE MANAGEMENT PLANNING REGULATIONS

Section

2.01 Purpose
2.02 Authority
2.03 Definitions
2.04 General Requirements
2.05 Local Participation
2.06 Review and Acceptance of Municipal Water Resource Management Plans
2.07 Adoption of Plans
2.08 Revision and Update

2.01: Purpose

The purpose of these regulations is to facilitate the development of comprehensive water resources management plans for Massachusetts and to assure that such plans are based on local, regional and state assessments of water needs and water resources; are in conformance with the Massachusetts Water Supply Policy; and are based on adequate data, aggregated by river basins. The plans are intended to provide a basis for state and federal action; to support and assist in providing for legitmate local needs for water supply, recreation, waste disposal, and other water-related uses and activities; to encourage water conservation; for flood control programs; drought contingency planning; and to provide a basis for legislative recommendations where appropriate.

2.02: Authority

The Water Resources Commission promulgates these regulations pursuant to MGL Chapter 21, Section 11, and in furtherance of its statutory duties, pursuant to Chapter 21, Sections 8 to 16, and Chapter 30A, its assigned tasks pursuant to Chapter 21A; and its function as the governor's designee pursuant to the Federal Water Resources Planning Act, PL 89-80.

2.03: Definitions

As used in 313 CMR 2.00:

(1) "Interbasin Transfer" means the transfer of water from one river basin to another.

(2) "Massachusetts Water Supply Policy" means the policies articulated in the "Massachusetts Water Supply Policy Statement" dated May, 1978, as accepted by the Secretary of Environmental Affairs under the provisions of the Massachusetts Environmental Policy Act, and endorsed by the Water Resources Commission.

(3) "River Basin" means any one of the drainage areas established by the Water Resources Commission as planning and management units for implementation of water resource management plans. These basins are consistent with those established by the Division of Water Pollution Control for implementation of federal and state water pollution control statutes.

(4) "Transfer of Water" means any movement of water, including wastewater, from one point to another by means of artificial conduits.

(5) "Water Conservation" means any planned or managed change in the manner or extent of use or distribution of water which results in a reduction in consumption, evaporation, or transfer without materially affecting or interfering with the attainment of the abjective of the use. Water conservation also means protection of existing and potential water sources by preventing or limiting the pollution of those sources.

(6) "Water Resources" means all the water, surface and ground, within, under, and flowing through a municipality, region or, river basin, of the Commonwealth, and includes interstate water courses, ponds and lakes and the coastal waters of Massachusetts.

(7) "Water Resources Commission" means the Commission established under MGL Chapter 21, Section 8 consisting of the Commissioners (or designees) of the Departments of Environmental Quality Engineering; Environmental Management; Fisheries, Wildlife and Recreational Vehicles; Metropolitan District Commission; Food and Agriculture; and Commerce and Development; and five public members,including a representative of the ground water industry, appointed by the Governor. The Commission has statuatory supervision and control over the Division of Water Resources and the Division of Water Pollution Control.

(8) "Water Resources Management" means the regulation, husbanding, protection, allocation, sharing, use, distribution, storage, treatment, diversion of water and protection from damage due to flooding. Such management also means the management of any land area which is directly related to the purposes of Section 1 and the application of any public funds to the furtherance of these purposes.

2.04: General Requirements

(1) Development of River Basin and Statewide Water Resource Management Plans. The Water Resources Commission ("Commission"), beginning in 1980, shall prepare and annually update a State Water Resource Management Plan, including plans for each river basin in Massachusetts. These plans shall be based on plans submitted pursuant to Section 2.05 of these regulations, and upon studies by

regional planning agencies, state agencies, the New England River Basins Commission and federal agencies and on such other information as the Commission may deem appropriate, and shall conform with the Massachusetts Water Supply Policy and other water resource management policies of the Commonwealth.

These plans shall be considered by State agencies in all decisions relating to water resources management, including allocation of resources, expenditures of funds and the making of legislative recommendations affecting policies and programs. No such decisions contrary to said plans should be finally made without the concurrence of the Commission, and no proposed actions contrary to such plans shall be endorsed by the Commission.

(2) Content of Plans. The Water Resources Management Plans formulated by the Water Resources Commission shall include at least the following types of data and projections, and such other relevent information as deemed appropriate:

(a) Demographic profile of the river basin (including both the current and projected population to be served by the water suppliers at the end of the planning period); and current and projected industrial and commercial growth. Such profiles shall be in accordance with the most current profile available from the state planning office;

(b) Per capita consumption and quantities of water used (both consumptive and non-consumptive) for industrial, institutional, commercial, residential, municipal, agricultural and other uses, both at present and projected to the end of the planning period;

(c) Current and projected water supply sources taking into account such factors as suitability as potable supplies, other non-potable uses, safe yield figures, potential alternatives of increasing supply, upgrading of water quality and the impact of future growth and sewer facilities;

(d) Insofar as possible, profile of the river basin including delineation of all surficial streams, stream flow data, identification of aquifers and aquifer recharge areas, estimated yields and existing and planned dams, diversions and power uses;

(e) Discussion of governmental and other entities within each basin with water resources management, operational and/or regulatory authority;

(f) Description of quality of surface and ground water, current and potential sources of contamination, and water

quality standards as approved by the Commission;

(g) Effectiveness of structural and non-structural means of flood damage reduction and low flow augmentation and maintenance and actions needed if such measures are not effective;

(h) Water Requirements for recreation, for fish and wildlife, and related utilization including those contained in the State Comprehensive Outdoor Recreation Plan (SCORP).

(3.) Full Development and Protection. The Water Resource Management Plans developed by the Commission shall describe measures proposed for full development and protection of local water supplies. Measures to be considered include, but are not limited to:

(a) The maintenance and updating of water resource inventories, including data on surface and subsurface supplies, to insure all potential sources have been identified;

(b) Review and consideration of the potential of all groundwaters as supply resources;

(c) The provision of additional protection to critical groundwater recharge areas (eg., acquisition, zoning);

(d) The preservation of future reservoir sites;

(e) Establishment of appropriate future uses and protection of surface and ground water for water supply, for industrial, institutional, commercial, residential, and municipal uses, energy, agricultural, recreational, fisheries and wildlife, or other purposes, including recommendations concerning assurance thereof and the reasons therefore;

(f) Water conservation including system rehabilitation (see Section 2.05 (3));

(g) Treatment requirements, and

(h) Zoning, acquisition or effective implementation of state and/or federal laws to provide protection of existing or potential sources of water supplies.

The Water Resources Management Plans developed by the Commission shall describe measures proposed for protection of lands subject to flooding, wetlands areas, ground water resources, fish and wildlife; for assurance of recreational opportunities; adequate supply and

pressure for residential, institutional, commercial, municipal and industrial users; and the other beneficial uses of water resources (eg., hydropower).

(4) Consistency Requirement. Insofar as possible, river basin and state plans should be consistent with other water related state and federal plans (eg., area-wide water quality management plans developed pursuant to Section 208, Federal Water Pollution Control Act, PL 92-500). If plans are inconsistent, the reasons for the inconsistency shall be identified and recommendations for resolution shall be specified.

2.05: Local Participation

(1) Local Plans. Pursuant to the requirements of Chapter 30A, Section 11B, the Commission shall afford full local participation by requesting the chief elected official or designee of each municipality to submit water resources management plans to meet 1985 needs and each five year period thereafter. The planning process should allow for full public participation and review. These local plans shall be integrated by the Water Resources Commission in its Water Resource Management Plans prepared pursuant to Section 2.04 (1) and Section 2.06 of these regulations.

(2) Plan Content. Each local water resource management plan should include local information as outlined in Sections 4B and 4C of these regulations as appropriate and feasible. (The Water Resources Commission will develop appropriate guidelines and standards to assist local communities in formulating their plans and to assure consistency among plans.)

(3) Water Conservation. Each municipality should consider and evaluate measures for conservation of water as those measures relate to the particular community. The plan should describe all measures deemed feasible and the programs which have been implemented or recommended for implementation.

At a minimum the following conservation-related measures should be considered in the preparation of each plan:

(a) Revision in local codes to maximize use of water conservation devices, water saving appliances or techniques used to reduce flows such as recycling and recovery systems;

(b) Water conservation education program;

(c) Voluntary or mandatory programs for leak detection and correction;

(d) Meter programs for full metering, and repair and replacement of defective meters;

(e) Rehabilitation of water distribution systems.

(4) Plan Submittal and Schedule. The water supply elements of local water resource management plans (Section 2.04, (a)(b)(c) and 2.04 (3) of these regulations) should be submitted to the Commission no later than December 31, 1979. Each municipality should simutaneously submit its plan to the appropriate Regional Planning Agency (RPA). Within 60 days of submission to the RPA, the Agency will forward its comments on the adequacy of the plans, conflicts between municipalities and other issues as they deem appropriate. The remaining elements should be submitted no later than December 31, 1981.

2.06: Review and Acceptance of Municipal Water Resource Management Plans

(1) Review by the Water Resources Commission. Water Resource Management Plans produced by municipalities will be reviewed by the Water Resources Commission upon submission. The Water Resources Commission shall consider such plans in light of the requirements and objectives of Section 2.04 and 2.05

(2) Plan Acceptance or Rejection. Those plans which the Commission finds adequate and acceptable shall be given full consideration in the River Basin and State Water Resources Management Plans developed by the Commission. The Commission may aggregate individual river basin plans into basins of larger area if deemed appropriate by the Commission (eg., Conn. River Valley). All inadequate plans shall be returned to the submitting municipalities within 90 days with recommendations for revision and resubmittal.

2.07: Adoption of Plans

(1) Schedule and Public Review. Prior to 1980, the Commission will establish a schedule for preparation of draft and final plans for each basin and a statewide plan. During 1980, the Commission shall begin preparation of draft state and river basin Water Resources Management Plans (or elements thereof) and shall submit them for review and comment to affected municipalities, to Soil and Water Conservation Districts, to the Secretary of Environmental Affairs, to appropriate regional, state and federal agencies, and to appropriate private, civic, environmental, industrial and business organizations. The Commission shall establish a formal public participation process should the Commission or the Secretary of Environmental Affairs determine that the issues identified in the plans indicate the need for a formal public participation process.

These plans shall include an assessment of conflicts between local plans, river basin plans and the statewide plan. Specific recommendations for action to resolve or adjudicate conflicts should be included.

The comments received will be reviewed by the Commission, a revised draft circulated and meetings of the Commission scheduled to discuss the revised draft plans.

(2) Commission Acceptance of Plans. The Commission upon completion of the foregoing steps shall at a regularly scheduled meeting vote to adopt or amend said water Resource Management Plans or elements thereof.

(3) Consistency Requirement. The adopted plans shall serve as a basis for decision making under Section 2.04 (1) and will be used to revise or amend state water supply policies, reassess water quality standards, determine funding priorities for advanced acquisition of reservoir and known aquifer sites and be used as a basis for recommending legislative action under the provisions of Chapter 21, Sections8 to 16 and 26 to 53.

2.08: Revision and Update

(1) Local Plans. Each municipality should from time to time and at the five year intervals,beginning in 1985, revise and update its local plan.

(2) River Basin and State Plans. From time to time, and at five year intervals beginning in 1985, or as the Commission deems necessary, water resources management plans may be updated and amended, provided that the requirements of Sections 2.07 (1) through 2.07 (3) are followed.

REGULATORY AUTHORITY

313 CMR 2:00 M.G.L. C.21

This regulation is a true copy of the regulation adopted by:

Water Resources Commission on December 11, 1978

Attesting signature: _____
(authorized agency official)

APPENDIX 4.

GROUNDWATER PRIMER*

The Hydrologic Cycle: There are two aspects to the hydrologic cycle: one is the familiar, visible circulation of water involving evaporation, precipitation and flow through a surface drainage network of lakes and streams; the other part of the cycle deals with the subsurface movement of water through the ground. The first is an observable phenomenon of the natural world; the second can only be inferred through analysis of water table fluctuation, base streamflow, and other empirical hydrologic data. (see figure 1)

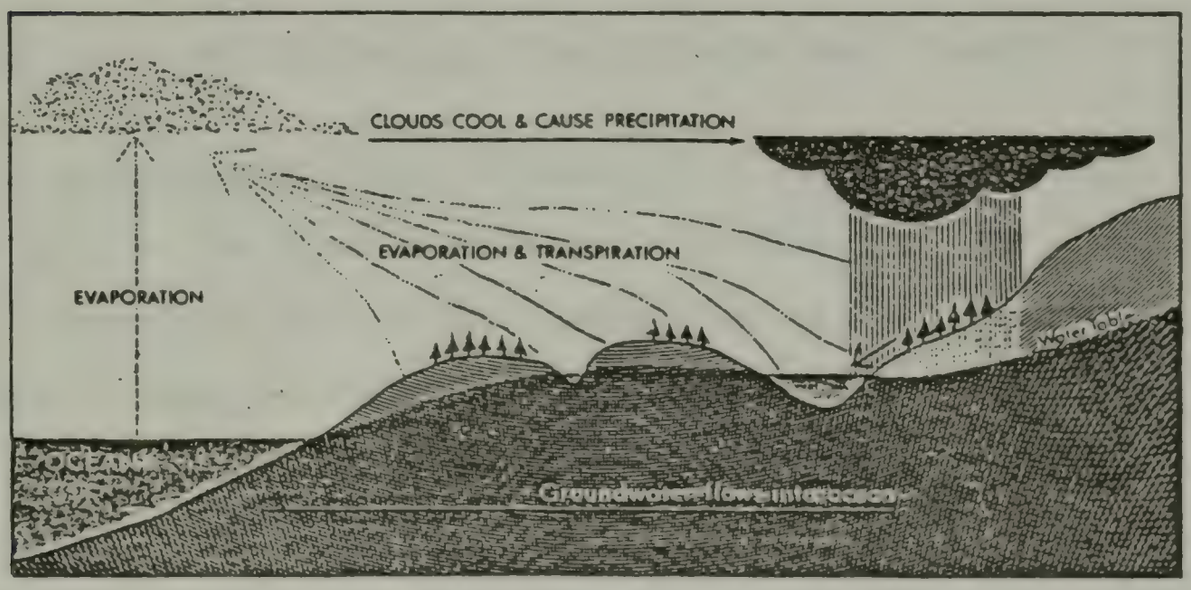


figure 1

The Hydrologic Cycle

* adapted from Groundwater and Groundwater Law in Massachusetts, Division of Water Resources, 1976

Since this primer deals with the interrelationship between ground and surface water, it will only briefly describe the visible portion of the cycle but deal extensively with the circulation of groundwater and surface water. One of the principal objectives of this primer is to explain the factors determining the conversion of surface water into groundwater and groundwater into surface water.

Energy: Energy from the sun provides the motive force in the hydrologic cycle; wind patterns determine the distribution of moisture on the surface of the earth; and the earth's gravitational field causes flow within the terrestrial part of the system, causing water to flow from points of higher elevation to points of lower elevation, with sea level acting as the ultimate base level.

Atmospheric Phase: Evaporation, driven by solar energy, is the upward movement of water from the earth to the atmosphere and is the process by which liquid or solid water is changed to a gaseous (vapor) form. It is influenced by the amount of heat from the sun reaching the earth, by air and water temperature, humidity, vapor pressure, wind movement, altitude and water quality. Transpiration is the second process contributing to the upward movement of water and represents moisture extracted from the ground and released to the atmosphere by plants.

Precipitation in the form of rain or snow is the downward component of the cycle from the atmosphere to the earth's surface and represents the conversion of water from the vapor phase to the liquid or solid phase.

Surface Phase: The hydrologic cycle can be either a simple or a complex process, involving two or more of the processes described above. In some cases precipitation may infiltrate the land surface only to be returned to the atmosphere by evaporation or transpiration. (The terms are frequently combined as the term "evapo-transpiration".)

The following equation is used by hydrologists to explain how precipitation gets distributed:

$$P=ET+I+R$$

P=precipitation, ET=evapo-transpiration, I=infiltration and R=runoff. During the winter when the ground is frozen and evapo-transpiration is at a minimum, almost all the precipitation which occurs ends up as runoff in the surface streams or in storage in the snowpack. During the spring when the snow melts and groundwater storage areas are fully recharged by infiltration, the flow of surface streams is highest and runoff is at its maximum. This is frequently a period of flooding. During the summer when evapo-transpiration is at its maximum, the amount of water flowing in the streams declines to its lowest level.

At this time , during the months of low stream flow, most of the water in a stream is provided by discharge from groundwater storage. In fall as evapo-transpiration becomes less, precipitation is divided between infiltration to groundwater storage and surface runoff. This seasonal cycle recurs year after year.

Sub-surface (groundwater) Phase: That portion of precipitation which is not returned to the atmosphere by either evaporation or transpiration and which does not directly become surface runoff filters down through the soil until it reaches the local water table, ie. a point in the material below the surface of the ground marking the top of the layer of water-saturated soil or rock, where every available opening is filled with water. In well-drained areas, the surface level of ponds, lakes and streams indicates the elevation of the local water table. Some infiltrating precipitation may, in places, encounter a subsurface layer of water-resistant rock or soil which prevents the water from reaching the water table, thereby creating a local "perched" water table.(see figure 2 below)

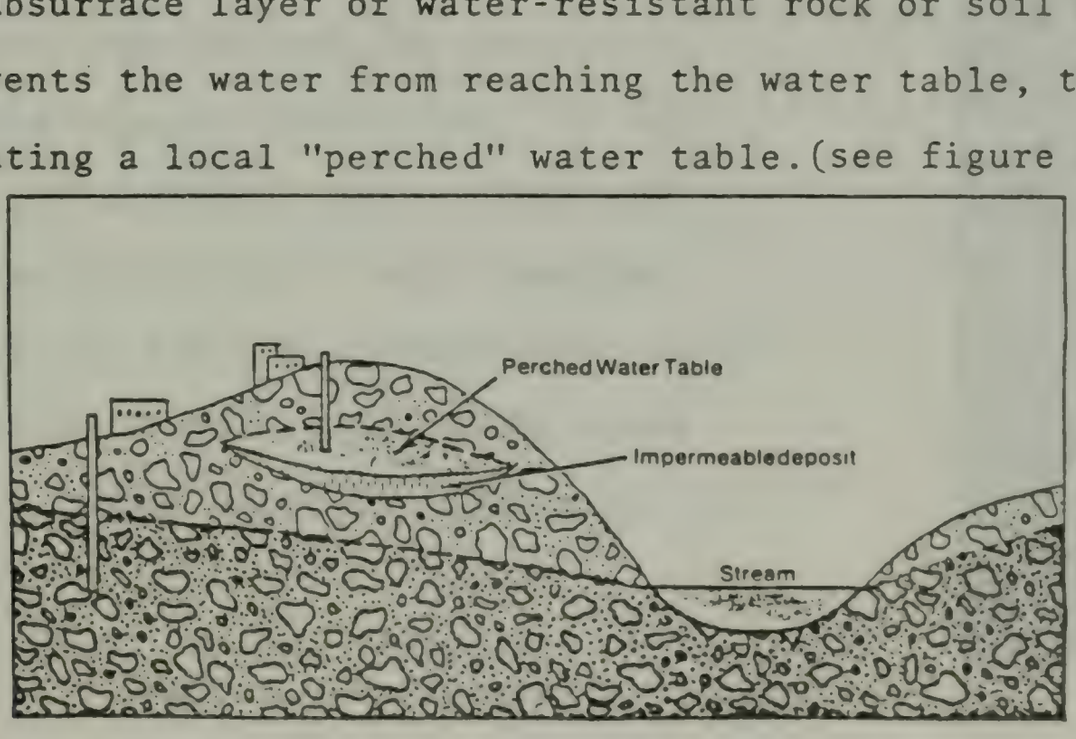


fig. 2
Perched Water Table

The standing height of water in an unpumped well is also a good indication of the elevation of the local water table.

Some water infiltrating to the saturated zone travels only a short distance before discharging into a surface stream or pond. On the other hand, some infiltrated water travels through the ground for great distances over a long period of time before reaching a point of discharge. All precipitation infiltrating the ground to the saturated zone continues to move vertically and laterally at a relatively slow rate toward places of groundwater discharge operating under the influence of the earth's gravitational field. Groundwater is the term applied to this slowly moving water beneath the land surface in the zone of saturation.

Figure 3 illustrates a ground water zone typical of New England, and , in fact, of most of the land masses of the earth. As shown, a single zone of aeration overlies a aingle zone of saturation. In the zone of aeration, these pores are filled partially by water and partially by air. The demarcation between these two zones is the water table, where water is at atmospheric pressure.

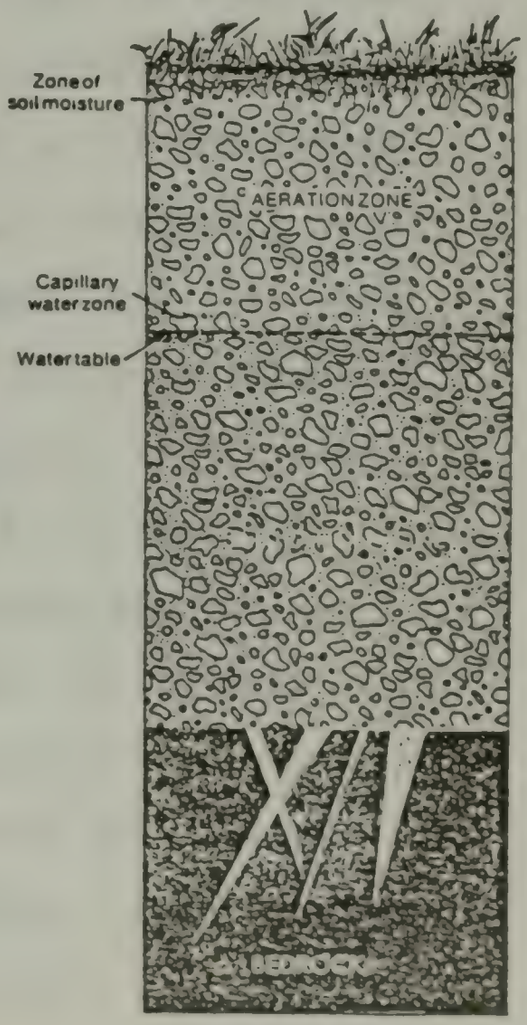


figure 3
Groundwater Zones

Let us trace the progress of a drop of water infiltrating from the land surface to the groundwater zone. The first area encountered is the soil water zone, or zone of soil moisture. Extending from the surface to the depth of major roots, the soil water zone is characterized by water held by molecular attraction. Plants are able to make use of the water held in thin films on the soil particles by capillary forces. The limits of water availability to plants are marked by the "wilting point" (lower limit) and "field capacity" (lower limit). Field capacity represents the amount of water remaining after gravity drainage. The drop of water has thus been subject to the forces of gravity, adhesion and cohesion (surface tension). The water in this drop could stay in this zone as "hygroscopic" water, bound to soil particles by adhesive forces and not available to plants, or it could also be taken by osmosis into a plant root and eventually be transpired back into the atmosphere. Below the soil water zone is an intermediate zone which can vary in thickness from zero to several tens of feet, depending on the depth to the water table. In this zone, water not captured earlier by the forces of adhesion, cohesion and osmosis is free to percolate downward in response to the pull of gravity. The same forces again play against the drop of water, and adhesion to soil perticles must occur before continued downward movement can take place. Here, stationary water, the equivalent of field capacity, is called

"pellicular" water.

The water continuing down is gravitational water; it will eventually reach the water table and finally become groundwater. Movement in the saturated zone is primarily due to gravity. It is to this zone that we try to sink all of our wells. The forces in effect in the zone of aeration are still present here and become evident when one tries to drain the zone of saturation by pumping a well. Some water will remain in the pores against the force of gravity, held by surface tension and adhesion. The volume of water held divided by the volume of soil holding it is called the "specific retention"; that volume of water released divided by the volume of the soil is called "specific yield." The quantities of each will vary with the physical makeup of the soil pores.

Figure 4 illustrates on a different scale the regional relationships within a groundwater basin.

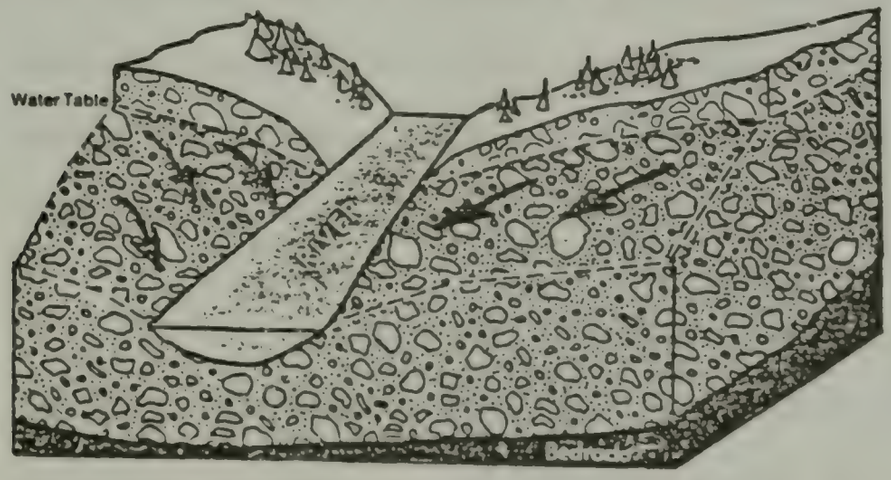


figure 4

Regional Groundwater Flow

An "aquifer" is a geologic formation which contains enough saturated permeable material to yield significant quantities

of water to wells or springs. A "recharge area" is an area in which water is absorbed that eventually reaches the zone of saturation. A "discharge area" is an area in which sub-surface water, including both groundwater and water in the unsaturated zone, is discharged to the land surface, to surface water, or to the atmosphere. In general, recharge areas are points of higher elevation on the landscape, and discharge areas have a lower relative elevation.

Consolidated and Unconsolidated Deposits: In most situations in Massachusetts, groundwater may be found either in the pore spaces between grains of unconsolidated or in the fractures and joints of unconsolidated deposits. There is one place where it is not commonly found: that is in the subterranean rivers flowing beneath the surface of the land, contrary to what superstition would have us believe. The closest resemblance to an underground river in Massachusetts is to be found in the dissolved cavities and passageways in some of the limestone formations in the extreme western part of the state. There, over the millenia, water has carved channels in the bedrock through which water can flow.

Except for the Triassic sedimentary rocks of the Connecticut Valley lowlands, the bedrock of Massachusetts consists primarily of igneous rocks or metamorphic sediments with little water-holding capacity; wells drilled

in most bedrock areas, therefore, yield enough for domestic supplies but not enough for municipal purposes in most cases. Overlying the bedrock, however, in some places, there are unconsolidated glacial deposits with much greater water-holding capacity; most municipal wells tap these unconsolidated glacial deposits because they are cpaable of storing large quantities of water. The amount of groundwater available from an aquifer, therefore, depends in part on the physical properties of the rocks and soils in a particular location and the volume of unconsolidated deposits.

Interrelationship of Surface and Subsurface Waters: If the hydraulic connection at the contact between a surface body of water and its adjacent slopes permits the free passage of water from one to the other, it is possible for groundwater to discharge into the surface water, during those times of year when the water table is above the level of the lake or stream. (see figure 5)

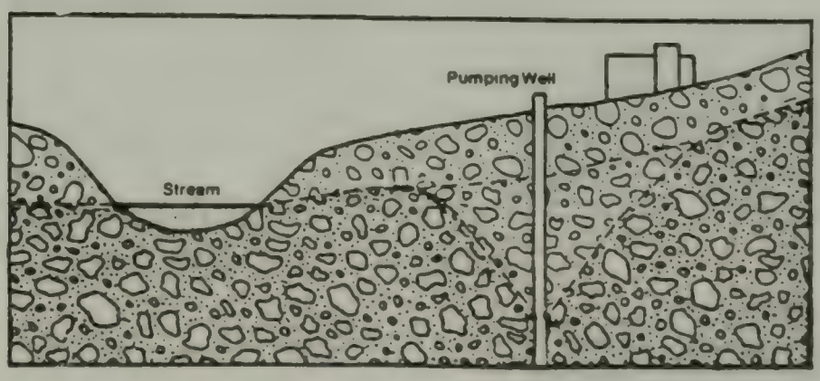


figure 5

Discharge of Groundwater to Surface Water

When the water table is below the level of the lake, the surface water can discharge into the groundwater. (see figure 6)

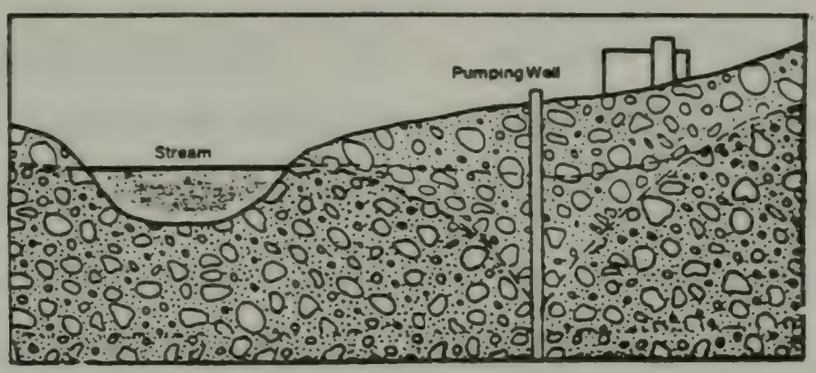


figure 6 - Infiltration from Surface Water to Groundwater

Given the free flow of water between surface and groundwater, the direction of flow will be determined by the height of the water table relative to the level of the pond or stream. Infiltration from a surface stream is sometimes induced when large quantities of water are withdrawn from the groundwater supply by a pumping well. This withdrawal of groundwater causes a drop in the local water table within the radius of influence of the well (see figure 7), stimulating the flow of water from the stream to the lowered water table.

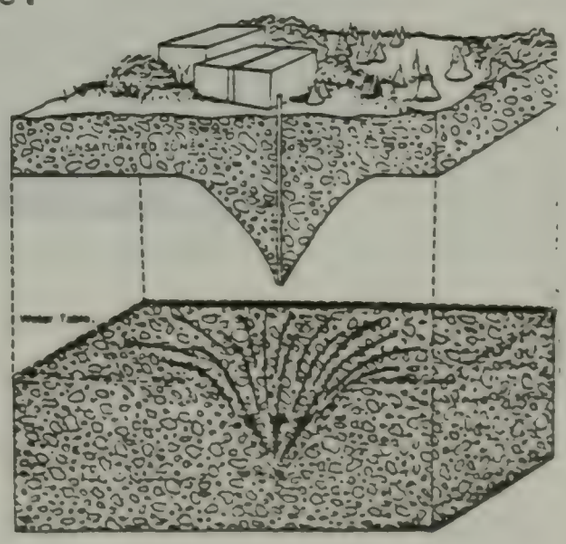


figure 7 -
Cone of Depression
(radius of influence)

Thus it is natural, given the right conditions, for groundwater to become surface water, and vice versa, as part of the hydrologic cycle.

Artesian Aquifer: Up to now all of the aquifers discussed have been unconfined aquifers, marked by the presence of a water table at atmospheric pressure. A confined, or artesian, aquifer is characterized by water at a pressure greater than atmospheric, which causes the static water level in a well tapping this type of aquifer to rise above the level of the water-yield layer of material. If the pressure is sufficient, the well may flow freely at the surface, without any pumping. (see figure 8)

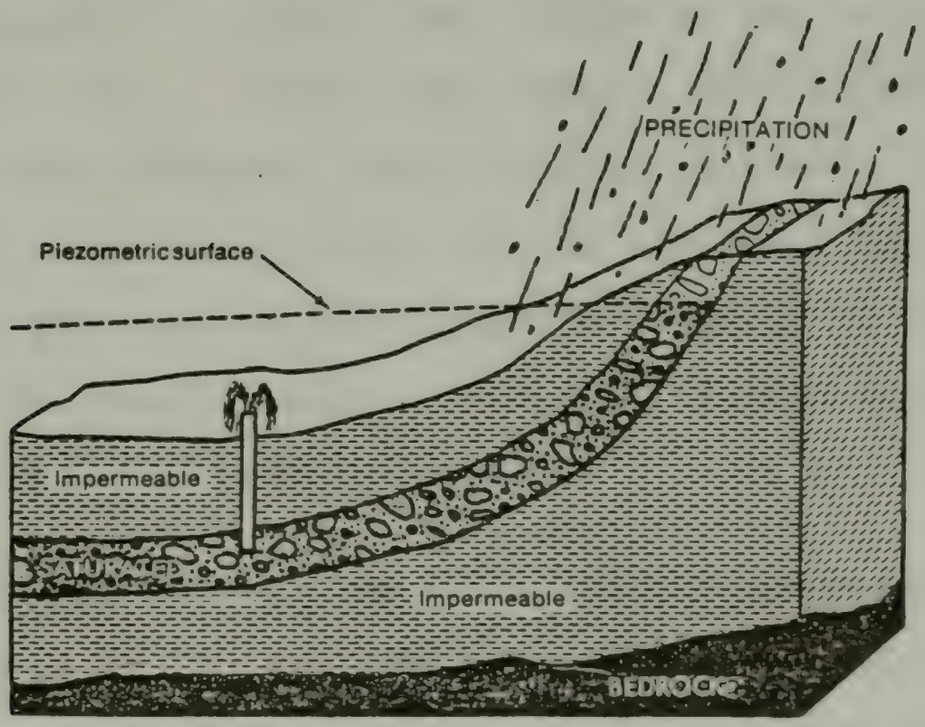


figure 8 - Artesian Aquifer

Water enters the aquifer at a recharge area and beomes confined by the impervious overlying materials in its flow toward a point of discharge. Unlike the upper

surface of an unconfined aquifer, the upper surface of the saturated zone of a confined aquifer remains fixed; changes in water levels in confined aquifers represent primarily a change in pressure rather than a change in volume of water as in unconfined aquifers. The water level corresponds to a pressure level called the piezometric surface.

Fluctuations in Water Table Elevations: The elevation of a water table fluctuates according to the relationship between recharge and discharge.

Seasonal fluctuations are normal. In the spring when recharge is greater than discharge the water table elevation rises. In the late summer, when discharge is greater than recharge, the elevation is lower. The topographic situation of a well is an important factor determining groundwater levels and their range of fluctuation; greater fluctuation occurs in wells situated on hilltops than in wells located in valleys.

There is a long-term correlation between precipitation and water table elevations, with higher elevations occurring during periods of average precipitation, and declining elevations resulting from years of drought.

Discharge of water from an aquifer by a well also causes a drop in the local water table or piezometric

surface near the well. The extent of drop in the water table is directly proportional to the amount of water being pumped from the well, and inversely proportional to the distance from the well. The relationship causes the depressed water table near a discharging well to assume a geometric cone-shape, as we saw in figure 7.

If water from an unconfined aquifer is withdrawn at a rate such that discharge is greater than annual recharge, there will be a decline in the regional water table. If water from an artesian aquifer is withdrawn at this rate, there will be a decline in the regional piezometric surface.

Water mining is defined as the process of decreasing the amount of water stored in an aquifer by discharging in excess of recharge. In coastal areas, the mining of water can result in salt water intrusion and contamination of the aquifer. This situation has occurred in Los Angleas, California, and is feared by many inhabitants of Cape Cod. There is danger in equating groundwater availability and the pumping capacity of a well. Although from an engineering point of view it is feasible to produce 1 mgd from a well located in highly permeable sand and gravel deposists, it is essential to take into account the hydrologic consequences of pumping at this rate for an extended period of time.

APPENDIX 5.

COMMUNITY INPUT

The Commission sent questionnaires to all key officials in the 351 communities of the Commonwealth in order to more clearly ascertain what the local supply problems were. Additionally, the Commission sponsored two "Public Seminars" which focussed on groundwater enhancement and protection and provided the communities an opportunity for dialogue with the Commission and technicians in the field of water supply.

This appendix summarizes the results from the questionnaire and brief synopses of the two seminars. The combined results document the need for a systematic approach to water resource management.

The Commission has gathered and assimilated the data and plans to continue working toward solutions to as many of the problems as possible while not jeopardizing the overall goal of an integrated policy.

QUESTIONNAIRE AND RESULTS

A questionnaire on Local Water Supply Issues was sent to all 351 communities of the Commonwealth. To date, December 1, 1978, 103 communities or the correspondent fire or water district have responded. The geographic breakdown of respondents follows: far western part of state - 4; Connecticut River Valley - 17; Central Massachusetts - 17; Metropolitan Area, Non-MDC - 10; Metropolitan Area, MDC - 8; North Shore - 18; South Shore, Southeastern Area - 18; Cape Cod - 11.

Twenty-four communities indicated current supply problems, at least on a seasonal basis. In Addition, fifteen other communities indicated that they project supply shortages beginning as early as 1985, some not until 2000.

Thirty-one communities indicated that they have water quality problems and will apply for state assistance, where and when applicable under Chapter 406 of 1978.

Forty-eight communities have indicated that they are in need of some form of state assistance, primarily financial to insure a continued adequate supply for their residents. System rehabilitation, leak detection and funding for studies to determine new sources of supply were the primary areas of financial need expressed.

Some of the respondents indicated that they have no

community water supply and are dependent on on-lot wells, while others indicated that they are dependent on regional supplies.

Additional responses to the questionnaire are still being returned and are being tallied. The information substantiates the fact that water supply problems are widespread and that communities are facing the problems; however, they need assistance.

The Commonwealth of Massachusetts

SPECIAL LEGISLATIVE COMMISSION
ON WATER SUPPLY

14 Beacon Street • Room 701 • Boston, MA 02108

Senate Chairman
CAROL C. AMICK

House Chairman
JOHN F. CUSACK

Research Director
DEAN R. JOHNSON

617 727-8422
727-8697

QUESTIONNAIRE ON

LOCAL WATER SUPPLY ISSUES

Dear Local Official:

We recognize that the demands on your time and staff resources are great. However, the Legislative Commission needs your input in order to report to the Legislature on the most pressing needs of local communities relative to water supply problems and to recommend legislative remedies which address those issues. Since this Commission will issue its first report in early December, we ask that you return this questionaire within the next two weeks if at all possible.

Thank you very much for your coooperation.

	yes	no
1. Are you presently experiencing any problem with the quantity of your community's water supply?	☐	☐
1a. If yes, what is current average consumption and safe yield (MGD)?		
2. Do you anticipate water supply shortages in the future?	☐	☐
2a. If yes, by what year?		
2b. What is your projected decifict?		
3. Are you presently engaged in a program to develop other local supplies?	☐	☐
3a. If yes, what source (surface or groundwater) and where:		
4. Are you presently experiencing any problems with the quality of your water supply?	☐	☐
4a. If yes, please describe (e.g., type of contaminant & source):		
5. Do you have any plans, or are you considering, any kind of water treatment facility?	☐	☐
5a. If yes, at what stage are your plans or discussions?		
5b. Have you applied for any state funding?		

6. Does your community have, or is it considering:
(check those programs you have or are considering; indicate which)

yes n

6a. Floodplain zoning
6b. Watershed protection
6c. Aquifer protection zoning
6d. Non-zoning wetlands protection
6e. A conservation commission
6f. Sub-division regulations
6g. Lake management
6h. Septic system management
6i. A road salting management plan
6j. Other water supply protection plans, regs, or mechanisms (please describe):

7. Does your community have any type of water conservation program? ☐ ☐

7a. If yes, please describe:
7b. If no, would you like technical assistance to develop one? ☐ ☐

8. What type of water rate structure is used in your community: (e.g., flat rate, declining block, fixture rate, ascending block, etc.)

9. Is your community currently considering changing its water rate structure or has it been changed recently? ☐ ☐

9a. If yes, please describe:

10. Do you have reasonably complete data on the age of your water distribution system? ☐ ☐

10a. Please estimate what percentage of your system is older than 50 years:
10b. Please estimate what percentage of your system is in need of replacement:

11. Do you have a regular leak detection and/or system rehabilitation program? ☐ ☐

11a. If yes, what is the current extent and cost of your program:

12. Please describe the kind of assistance, if any, that your community needs from the state to insure the continued adequacy of its water supply:

13. Name of community: 13a. Date:

14. Name/title of respondent(s):

(Please use additional sheets to respond to questions if needed. If you desire further information about the work of the Commission, please call 617/727-8422. Thank you.)

Senate Chairman
CAROL C. AMICK

House Chairman
JOHN F. CUSACK

Research Director
DEAN R. JOHNSON

The Commonwealth of Massachusetts

SPECIAL LEGISLATIVE COMMISSION ON WATER SUPPLY

14 Beacon Street • Room 701 • Boston, MA 02108

617 727-842
727-869

PUBLIC SEMINAR ON THE PROTECTION AND ENHANCEMENT OF PUBLIC WATER SUPPLIES

UMass School of Business Administration
November 14, 1978 1:30-5 P.M.

AGENDA

1:15 Registration

1:30 1. Introductions - Rep. John Cusack and Dr. Madge Ertel

1:45 2. Current Initiatives Affecting Water Supply

* National vs. Regional Water Policy - Sen. Carol Amick

* Mass. Water Resources Commission

2:15 3. Groundwater Management

* Groundwater Issues in Mass.- 3 Case Studies - Walter Mulica, Interdisciplinary Environmental Planners

* Connecticut's Approach to Groundwater Management - Dr. Hugo Thomas, State Geologist and Director, Natural Resources Center, Conn. Dept. of Environmental Protection

* Legal and Technical Issues in Groundwater - Dr. Ward Motts, Prof. of Geology, UMass Amherst

3:00 COFFEE BREAK

3:15 4. Water Conservation

* Conservation Techniques for Communities - Jay Stryker, ECOS, Inc.

* Massachusetts Jaycees Conservation Program - Jay Stryker

* State-Funded Conservation Research Projects - Elizabeth Kline, Mass. Assn. of Conservation Commissions

3:45 5. Local Water Supply Issues
(Presentation of issues from community representatives and open discussion among attendees, Commission members and resource people.)

5:00 ADJOURN

SYNOPSIS OF COMMISSION SEMINAR AT AMHERST

Opening remarks were made by Rep. Cusack, House Chairman, who introduced members of the Commission present and stated that the Commission had been established by Chapter 13 of the Resolves of 1977 in response to a concern over local water supply problems throughout the Commonwealth. He introduced De. Madge Ertel, acting director of the UMass Water Resources Research Center, who welcomed the opportunity for local communities to get together with the legislators and the university to exchange information on the crucial water supply situation in the Commonwealth.

Senator Amick, Senate Chairman, spoke briefly on Federal Water Policy and its implications for state water resource management. She mentioned President Carter's water policy speech of June 6, 1978, in which he indicated a willingness to redirect federal programs in four key areas: 1) improved planning for efficient management of federal programs, 2) incorporation of water conservation as an integral part of all federal water programs, 3) improved state-federal cooperation and 4) increased attention to environmental quality in allfederal programs. The President plans to request $25 Million for a cooperative program of technical assistance in water reource management (Title III). Sen. Amick reiterated the importance of input from communities throughout the Commonwealth in helping the Commission to fulfill its mandate.

Rep. Cusack introduced Mr. John Balco, Executive Director of the Water Resources Commission, who spoke briefly about the WRC, its composition and the areas of resource management they have identified as crucial: allocation of water supply (including considerations of diversions), water resource planning with Title III funding, and the integration of water conservation into overall water resource planning. He spoke also of the new regulations being proposed by the WRC.

Dr. Ward Motts. of the Deaprtment of Geology at UMass addressed several legal and technical issues relating to groundwater protection, including the fact that Massachusetts' groundwater laws are all based on common law, and fail to address the relationship between ground and surface water. He voiced the need for an office of groundwater planning staffed with geologists, engineers and hydrochemists. The purpose of this office would be to analyze data from USGS and other hydrologic data.

Dr. Hugo Thomas, state geologist for Connecticut, outlined Connecticut's approach to systematic water resource management, which entails: 1) centralized data collection on all natural resources, for state and cooperative state-federal programs, 2) a total natural resources approach, 3) the Natural Resources Center acting as staff to all line agencies and 4) complete coordination of all efforts at all levels of resource management. The system is completely

computerized so that data are easily accessible.

Walter Mulica of Interdisciplinary Environmental Planners, Inc., discussed three case studies conducted by IEP on representative communities -- North Reading, Hanover and Stow. These illustrated techniques for locating and evaluating potential groundwater sources and recharge areas, as well as mapping and strategies for protection of current and future supplies.

Jay Stryker, representing ECOS, Inc., and the Mass Jaycees, spoke of the economic benefits of water conservation and the types of low-flow devices available. He cited the savings realized by Boston University when, last year, they spent $15,000 for the devices and saved $75,000 in fuel bills and $25,000 in their water bills.

After the coffee break, the Commission heard from representatives from the communities of Amherst, Ayer, Belchertown, Holden and Pelham.

AMHERST - Mr. Hayward and Ms. Eddy spoke of the situation in Amherst, caused primarily by the drought-like conditions of the past few months. Ms. Eddy, in answering Rep. Cusack's question about Amherst buying water from Hadley, stated that: 1) the quality of Hadley's water is not suitable for all the University's needs and 2) the present arrangement confers mutual economic benefits on both the town and the University. The town has instituted several water

conservation methods, including banning car washing, serving water in restaurants only on request, shutting off the air conditioning early in most University buildings. Amherst charges a flat rate of 34¢/100 cu.ft. for their water, and does not make a habit of discounting large users. The town feels it deserves special attention from the legislature if their most recent search does not yield new sources, because the state university accounts for approximately half the total water consumption.

HOLDEN - Mr. Kennedy, Town Manager, discussed Holden's water-rich, water-poor status, brought about by numerous special legislative acts which granted water and water rights from within the town to other communities. Holden sees no alternative but to file for its own special act, to tap into some of these water rights. Holden has taken conservation measures and has changed their water rate structure three times in the last nine years, most recently to a flat rate of 70¢/100 cu.ft. Mr. Stickel asked if consumption had decreased in response to the increased rate -- Mr. Kennedy replied that industries were using less than Grade A water for cooling purposes, and that for the first 36 months there had been a decrease in domestic consumption, which now seems to be on the rise. The next step, Mr. Kennedy added, is to institute and increasing block rate.

AYER - Mr. Redfield identified the problem in Ayer as being one of quality, due as much to the old pipes as to

the iron and manganese present in the water, and mentioned the need of small communities for the type of financial assistance provided in Chapter 406 of 1978.

BELCHERTOWN - Mr. Whitlock stated that he sees water as a limit to growth. Belchertown is one of the fastest growing communities in the Commonwealth, and he sees a future problem in providing water for all residents. He asked about the possibility of a regional hook-up with Amherst into the Quabbin; Rep. Cusack responded that at this time, it is highly unlikely.

PELHAM - Mr. Larson spoke of what he sees as the state's responsibility to protect water supplies from excessive road salting and poor sewer and septic management. Two families in Pelham have lost their on-lot wells due to contamination from road salting on Route 202.

Mr. Iontosca and Mr. Gurvitch commented on state responsibility, state programs and the relationship to past budget cuts and the fact that this year we will probably face more cuts, given the mood of the people and the promises of the governor-elect.

Rep. Cusack responded by saying that one of the roles of the Commission is to convince the Legislature and the Executive of the needs and priorities relating to a continued adequate water supply for the Commonwealth.

Senate Chairman
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The Commonwealth of Massachusetts

SPECIAL LEGISLATIVE COMMISSION ON WATER SUPPLY

14 Beacon Street • Room 701 • Boston, MA 02108

617 727-842
727-869

PUBLIC SEMINAR ON THE PROTECTION AND ENHANCEMENT OF PUBLIC WATER SUPPLIES

Gardner Auditorium — State House
November 16, 1978 — 1:30 - 5 P.M.

AGENDA

1:15 Registration

1:30 1. Introductions - Sen. Carol Amick and Dr. Madge Ertel

1:45 2. Current Initiatives Affecting Water Supply

* National vs. Regional Water Supply
* Massachusetts Water Resources Commission - Member

2:15 3. Groundwater Management

* Groundwater Issues in Mass. - Case Studies - Walter Mulica, Interdisciplinary Environmental Planners
* The U.S.G.S. Cooperative Survey Program - Dr. Michael Frimpter, Chief of Hydrologic Studies, New England District United States Geologic Survey
* Water Resources Protection Techniques - Alexandra Dawson, Esq., General Counsel, Metropolitan Area Planning Council

3:00 COFFEE BREAK

3:15 4. Water Conservation

* Conservation Techniques for Communities and the Mass. Jaycees Conservation Program - Gail Peterson, ECOS, Inc.
* State-Funded Conservation Research Projects - Elizabeth Kline, Mass. Assn. of Conservation Commissions

3:45 5. Local Water Supply Issues
(Presentation of issues from community representatives and discussion among participants.)

5:00 ADJOURN

SYNOPSIS OF COMMISSION SEMINAR AT BOSTON

Opening remarks were made by Sen. Amick, Senate Chairman, who introduced members of the Commission indicating the broad base of support. She stated that the Commission was formed by Chapter 13 of the Resolves of 1977 and was funded for two years to investigate the quantity and quality of drinking water in the Commonwealth. After welcoming representatives from the communities, she introduced Dr. Madge Ertel of the UMass Water Resources Research Center. Dr. Ertel mentioned that UMass welcomed the opportunity to expand its relations with the legislature and fulfill an informational role with communities on the part of the University. She hoped that the educational aspects of the program would be universally enlightening.

Sen. Amick then introduced Mr. Johnson, Research Director for the Commission who presented a synopsis of the federal-state water policy realtionship. Mr. Johnson stressed the need for "conservation as the cornerstone" of a systematic approach to water management as outlined by the President in his water policy statement of June 6, 1978. The four key areas outlined by the President are: 1) improved planning for efficient management of federal programs, aimed primarily at western dam projects, 2) incorporation of water conservation as an integral part of federal programs, 3) improved state-federal cooperation and 4) increased attention to environmental quality in all federal programs.

The Commonwealth serves to further benefit from increased federal awareness by being eligible for part of the increased Title III funding for technical assistance in water resources management. The Commission well continue to work with federal officials to insure that Massachusetts will see some of that money.

Sen. Amick introduced Mr. Balco of the state Water Resources Commission who outlined the membership and responsibilities of the WRC in terms of water resource management. He expanded upon the proposed new regulations which all Regional Planning Agencies, Conservation Commissions and Planning Boards should have received which outlines proposed water basin planning. He further discussed the priorities of the state water supply allocation plans; 1) allocation of water supply, 2) water resource planning with Title III funding, 3) water conservation as an integral part of all water planning and 4) groundwater aquifer protection regulations. He emphasized that the order of presentation did not indicate priorities and stressed that each is equally significant in and of itself and in relation to each of the other priorities.

Dr. Frimpter of the United States Geologic Survey (USGS) outlined their cooperative survey programs. One such survey is a basic geologic survey; approximately 5/6 of the state has had this survey done. USGS also has conducted detailed groundwater assessments and hydrologic

aquifer identification surveys for the Cape Cod area. The rest of the state needs to be done. The program operates on a 50-50 matching basis. USGS is willing to supply the technical expertise, but needs assurances of multi-year funding in order to begin the extensive surveying needed for total groundwater identification and protection.

Ms. Dawson, legal counsel for the Metropolitan Area Planning Council (MAPC), spoke about the need for data collection and assimilation. She queried "What good is a brick in the toilet when we are systematically poisoning our groundwater?" She stressed the need for more comprehensive studies of contaminants and water supplies. Grcund-water Laws, based on common law, with the connnection between ground and surface water need to be rewritten but not until positive proof is established to show the interrelationship between the waters of the Commonwealth.

Mr. Mulica from Interdisciplinary Environmental Planners, Inc. (IEP), discussed three case studies conducted by IEP on representative communities -- North Reading, Hanover and Stow. These illustrated techniques for locating and evaluating potential groundwater sources and recharge areas as well as mapping and strategies for protection of current future supplies.

Ms. Kline from the Massachusetts Association of Conservation Commissions spoke about project grants available for research and demonstration water conservation projects.

The projects must fulfill the following criteria: must 1) be a research project with an hypothesis, 2) be a demonstration project, 3) have a demonstrated commitment on the part of the locality, 4) be a cooperative effort among local community boards and 5) should have a link to other programs with funding sources.

Ms. Peterson of ECOS, Inc., briefly described the water conservation devices being marketed by ECOS and the Massachusetts Jaycees. ECOS will help communities plan water conservation programs, if so requested.

After the coffee break, the Commission heard from representatives from the communities of Bedford, East Bridgewater, Ipswich, Lakeville, Leominster, Shirley, Stoughton and Taunton.

SHIRLEY - Dr. Field identified the problem in Shirley as one which may have severe implications for the State Wetlands Protection Act. A large gravel mining company has situated its new gravel mining pit over a deep underground aquifer. The case is currently in court. The town alleges that mining would seriously alter the town's water table; the company alleges they are within the law because they are more than 100ft. from the town's wetlands.

STOUGHTON - Mr. Love discussed many of the water supply problems facing Stoughton. Based on a Camp, Dresser and McKee study, Stoughton has to date developed all the

town-sized wells. They are currently exploring the possibility of wells of less than town-size to augment current supplies. Current per capita usage is 77GPD/person. Stoughton has faced the fact that an immediate MDC hook-up is not possible. The town has taken conseravtion measures and has a special water committee to look into possible solutions.

LEOMINSTER - Mr. Julian stressed that the problems confronting Leominster primarily relate to protection of present supply. Money for maintenance and rehabilitation is critical particularly for increased protection of watersheds. Better forestry practices such as cutting deciduous trees, improved drainage systems for the roads abutting the reservoirs and better control of the road salting program is needed.

IPSWICH - Mr. Pierce and Mr. Morse addressed the issues facing Ipswich and the Ipswich River Watershed. Conservation is crucial or the Ipswich river will dry up. Presently, a portion of the Ipswich flows backward to recharge an overpumped section of the river. Also needed for Ipswich is the formulaiton of a clear legislative mandate to fully fund a regulatory body to maintain, allocate and conserve the water supply in the Ipswich River Basin.

BEDFORD - Mr. Folweiler stated that the problems in Bedford are caused primarily by industrial pollutants con-

taminating the town wells. Bedford is in consultation with DEQE and Division of Water Supply. Bedford is instituting conservation measures, including a sifnigicant ascending block rate.

LAKEVILLE - Mr. Murphy stated that Lakeville's problem is related to the cost of protecting water supplies, approved by the Legislature, for the cities of Taunton, New Bedford and Fall River. Lakeville would like state assistance in protecting these water supplies.

DANVERS - Mr. Fischer made three points: 1)ultra water conservation is not effective because it is not cost effective, 2) he supports the statement that a new agency in the Ipswich is not necessary; prefers granting further authority to DEQE and 3) economic development in the Commonwealth will be hurt if the excessively negative image of water/conservation/shortages is pursued. He recommends public education on conservation and fully charging water utility costs to users through rates.

TAUNTON - Mr. Heap stated that the greatest need he sees for the city of Taunton is for financial assistance for system rehabilitation and an accelerated program for Chapter 406 funding. In addidtion, he sees the logical progression of closing the water loop from distribution of water and recharge is to use treated wastewater innova - tively.

EAST BRIDGEWATER - Mr. Perrault would like to see a readdressing of the needs of the smaller communities of the Commonwealth in terms of financial assistance from the state. He requested a vehicle for financial assistance to allow smaller communities to participate in studies to identify good groundwater.

Dr. Mobbs - A former of the State Pesticide Board, Dr. Mobbs cautioned that potential contamination of water supplies could result from improperly handled, stored or applied pesticides, especially into groundwater where any of the aforementioned can seep essentially unknown to the residents. Current law is strict about surfacewater but not as concerned about groundwater.

SOUTHEASTERN REGIONAL PLANNING & ECONOMIC DEVELOPMENT DISTRICT - Mr. Reckhow addressed water supply protection programs with the EPA. He felt that completion of the statewide effort to map out the state hydrologically is critical to overall statewide water resource planning. When drawing maps, however, he cautioned that recognition must be paid to the fact that seldom do water supplies follow municipal boundries. Additionally he states that a provision should be made to sample private wells on a regular basis, much as is currently done with wells used for public supply.

Represented at Amherst Seminar, November 14, 1978

COMMUNITIES

Amherst
Ayer
Belchertown
Chicopee
Goshen
Hadley
Holden
Longmeadow
Rutland
Springfield
West Brookfield
West Springfield
Westminster
Wilbraham
Williamstown

AGENCIES AND ORGANIZATIONS

Berkshire County RPA
Hampshire County RPA
Lower Pioneer Valley RPC
MA. Steering Committee on the Connecticut River
M.D.C.
Northfield CAC
S.C.A.R.C.E. (Amherst Committee)

OTHER INTERESTED PARTIES

Curran Associates
Cooperative Extension Service
Sen. Kennedy's Office
UMass Public Health Center

Represented at Boston Seminar, November 16, 1978

COMMUNITIES

Barnstable
Bedford
Danvers
East Bridgewater
Hingham
Ipswich
Lakeville
Leominster
Milton
Needham

North Reading
Onset
Sagamore
Stoughton
Taunton

AGENCIES AND ORGANIZATIONS

Cape Cod Planning and Economic Development Committee
EOEA
Friends of the Earth
Ipswich River Watershed Assoc.
Mass Audobon Society
MAPC
MDC
Mystic River Watershed Assoc.
Nashua River Watershed Assoc.
Neponset Conservation Assoc.
NERBC
Southeastern Regional Planning and Economic Development District
USGS

OTHER INTERESTED PARTIES

Camp Dresser & McKee
Comm. on Natural Resources and Agriculture
Rep. Heekler's Office
Haley & Ward, Inc.
Rep. Minahan
SEA Consultants
Skidmore, Owings & Merrill

APPENDIX 6.

CASE STUDIES OF LOCAL WATER SUPPLY ISSUES

The Special Legislative Commission on Water Supply has investigated the water supply problems and needs of as many communities in the Commonwealth as time has permitted. Sources of information have included a questionnaire which was distributed to all 351 towns and cities of the Commonwealth and two public seminars (see Appendix F); direct contact with local elected officials, water superintendents, and citizens; local and regional planning and engineering studies; the various agencies within the Executive Office of Environmental Affairs; and the Massachusetts Water Supply Policy Statement.

The following case summaries were selected as representative of the water shortage, water quality, and supply protection issues prevalent in the Commonwealth. The intent has been to highlight specific problem areas rather than to provide a comprehensive listing of each community's needs. In fact, many communities are experiencing problems in more than one area. All projected data for 1990 was derived from the Water Supply Policy Statement for consistency. It should be noted that local engineering studies frequently are based on higher population projections and, therefore, project greater future supply needs.

Index to Case Study Summaries

Water Supply Shortage Issues

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12. Lee

Water Supply Quality Issues

13. Bedford
14. Fall River
15. Goshen
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Water Supply Protection Issues

22. Burlington
23. Hanover
24. Lakeville
25. Leominster
26. Pepperell
27. Salisbury
28. Shirley

1. AMHERST

WATERSHED - Connecticut River Watershed
SUPPLIER - Amherst DPW
SOURCES * - Hill and Hawley Reservoirs in Pelham - safe yield .91 mgd
- Atkins Reservoir System in Shutesbury - safe yield .94 mgd
- Brown Well in Belchertown - safe yield 1.3 mgd
- South Amherst Wells - safe yield 1.04 mgd
- Brickyard Wells in Amherst - safe yield .36 mgd
- Total safe yield of sources 4.55 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 3.18 mgd*	-Average Daily - 5.0
-Maximum Daily - 4.5 mgd*	-Maximum Daily - 9.9
Service Population - 23,000	Service Population - 37,200

*indicates that information was taken from the Master Plan of Water Supply Sources done for Amherst by Tighe and Bond in July 1978

The town of Amherst has for some time been seeking to augment its water supplies. Increasing enrollments at the University of Massachusetts and growth in the number of permanent town residents have put rapidly escalating demands on the water supply system. Present peak day demands (occurring from September - December) are just about equal to the total safe yield of the system; the town seeks an immediate increase of 1.3 mgd to put a cushion between demand and safe yield, and hopes for an increase of 2.7 mgd by 1990.

The water supply shortage became acute in September; fall term began at UMass, which accounts for 50% of the

town's total consumption. There had been little rain, and there simply was not enough water to go around. The University took several water conservation measures, including turning off the air conditioning in 14 buildings, saving 100,000 gpd, and installing water-saving shower-heads in 43 dormitories. Amherst and Hampshire Colleges, and Amherst public schools, took assorted conservation measures. The Board of Selectmen voted to ban watering of lawns, car washing, and air conditioning except where it was absolutely necessary.

Meanwhile, the town searched for a way to augment the water supplies. On September 29, the Hadley Board of Selectmen voted to supply Amherst with up to 300,000 gpd through an emergency connection. By late November, water levels in Amherst's Pelham Reservoir were back to normal for that time of year, and the emergency connection from Hadley was terminated. Amherst faces the prosepect of renewed shortages by late spring of 1979 if winter precipitation is below average.

Amherst has been searching for new water supplies for many years. In response to a similar shortage in 1975, the U.S. Geological Survey and the Water Resources Commission prepared an "Assessment of the Water Resources of the Amherst-Hadley area, Massachusetts." That study, which was based on existing data only, identified potential groundwater sources and recommended more detailed

evaluations, including drilling tests. However, funding has not been made available from the state to provide the required matching funds for U.S.G.S.

In July 1978, Tighe and Bond, Amherst's consulting engineers, completed a study of Amherst's water supply system which outline the various options for augmenting their supplies. In the short run, they recommend that the town repair and upgrade the dams and chlorination facilities at the Hills and Hawley Reservoirs in Pelham, and repair the dam and add a second chlorination unit at Atkins Reservoir.

Long-term options include: development of wells in the Lawrence Swamp area, presently the most promising alternative although the water has a high iron concentration; obtaining water from Quabbin Reservoir, which is not a viable option currently in light of the fact that the Quabbin's safe yield is already chronically overdrawn; and receiving water from Hadley. The town is also actively pursuing the development of a conservation program but needs technical assistance to develop new billing procedures, educational materials, and other approaches to managing consumption.

2. BOSTON

WATERSHED - Charles/Mystic/Neponset: Charles River Sub-Basin
SUPPLIER - Boston Water and Sewer Commission
SOURCES - MDC - safe yield 141.7 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 143.4 mgd	-Average Daily - 153.3 mgd
-Maximum Daily - 160.7	-Maximum Daily - 161.0 mgd
Service Population - 628,000	Service Population - 616,000

Boston is the largest user within the MDC system, accounting for roughly 45 percent of total MDC consumption. The Boston system serves 90,000 customers, contains 1,080 miles of pipe, and has 13,300 fire hydrants. As the safe yield of the MDC system is exceeded, and as pressure for the MDC to supply new communities grows, Boston faces the prospect of inadequate supplies by 1990--and much sooner if a drought should occur.

One of the primary concerns of the Boston Water and Sewer Commission is unaccounted for water. According to the estimates of the 1975 "Metropolitan District Commission Water Usage Study" (the 'Curran Report'), approximately 48 million gpd were unaccounted for in 1972, after making allowances for normal system losses, fire fighting, and public and other unmetered usage. Though based on 1972 data and less than complete information, that estimate indicates the magnitude of the probable leakage problem.

Boston has responded to this problem with a comprehensive leakage survey and an intensive remetering program. One leakage survey in Brighton has reduced the amount of water going into that portion of the system by 800,000 gallons per day, and smaller savings are being realized on a regular basis as a result of leak detection. Expenditures for leak detection currently are between $50-55,000 per year, and the cost of the remetering program is $1.3 million per year.

A major presumed cause of unaccounted for water in Boston's system is leakage from antiquated pipes. Boston estimates that roughly 20 percent of its distribution system (212 miles) needs immediate repair or replacement. The goal of replacing all pipes over 100 years old by the year 2000 is estimated to cost $100 million over the next 21 years. As with other older communities in the Commonwealth, the financial burden of distribution system rehabilitation is overwhelming.

Boston has increased its water rates since the formation of its Water and Sewer Commission to reflect the true costs of water delivery (though total rehabilitation costs are not reflected.) The result has been a tripling and quadrupling of many residents' water bills and resultant pressure to bring the rates under control. Boston's water rates are among the highest of any city in the nation today.

In addition to leakage control and system rehabilitation, a third area of concern for Boston is the problem of damages, judgments, and losses due to water damage claims. The Water and Sewer Commission explored obtaining private insurance in 1978, but they found the cost to be prohibitive. Fiscal planning with such a large area of uncertainty is exceedingly difficult, and Boston has recommended the creation of a federally-funded insurance pool.

3. BROCKTON

WATERSHED - Taunton River Watershed
SUPPLIER - Brockton Water Department
SOURCES - Silver Lake - 9 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 12 mgd	-Average Daily - 13.761 mgd
-Maximum Daily - 20 mgd	-Maximum Daily - 27.552 mgd
Service Population - 95,967	Service Population - 106,000

The city of Brockton is one of the six regional water suppliers in the Commonwealth. It derives its supply from Silver Lake in Pembroke, and has a backup reservoir in Avon. From October to May, waters from the Monponsett Pond in Hanson/Halifax and Furnace Pond in Pembroke are diverted to Silver Lake. Brockton supplies water to Hanson, Halifax and Whitman, who together account for 10% of consumption in the system.

The safe yield of Silver Lake is 9 mgd and total consumption for the system averages 12 mgd (20 mgd on peak days); the result is a severe shortage of water. One proposal to augment supplies is the diversion of the Jones River in Kingston; this would increase safe yield to 12 mgd. The authority for the diversion has to come from an act of the Legislature. Under current guidelines for diversion, as set forth in the Water Policy Statement (and Commission Resolutions on Major Water Supply Augmentation Projects), Brockton must first exhaust its local resource options,

foremost of which is groundwater from an aquifer in Hanson - Pembroke.

Another "local resource option" is a water conservation program; this was also recommended in the Old Colony Planning Council's 208 plan for the city. Brockton has a public information program and has instituted summer water bans. The city is 100% metered, and the water department has for several years been engaged in a meter replacement program at the cost of $75,000 a year. Water rates, recently raised for the first time in 63 years, are on a declining block rate, based on operating costs rather than system replacement; bills are sent out twice yearly.

4. COHASSET

WATERSHED - South Shore Watershed; Main River Sub-basin
SUPPLIER - Cohasset Water Department
SOURCES - Lily Pond Well - .66 mgd; Hingham Water Company .09 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - .66 mgd	-Average Daily - 1.169 mgd
-Maximum Daily - 1.0 mgd	-Maximum Daily - 3.425 mgd
Service Population 7,500	Service Population 9,750

Cohasset has periodic water shortages, primarily in the summer months when it institutes water bans on all non-essential uses. It has recently expanded its supply capabilities and is developing the Bound Brook Reservoir which will have the capacity of 1.16 mgd. Cohasset anticipates no further problems. Cohasset also has a water treatment plant with a 3 mgd capacity which utilizes a rapid sand filtration method of purification. The treatment plant is 60 years old and the town watches carefully for signs of need of renovation. This is consistent with the town's policy of a two year cycle for leak detection.

The water rates in Cohasset are based on a self support -true cost reflective structure. Residential users are charged $21.50/1500 cu.ft. per quarter with commercial users being charged on a sliding scale of $1.75/100 cu.ft. The town is 100% metered and has no real difficulty in meeting the financial demands of water supply maintenance,

leak detection and treatment because the customers assume all costs. The town is beginning to study system rehabilitation needs and estimates that 90% of its system is over 50 years old; approximately 40% may need replacement or drastic renovation.

5. GLOUCESTER

WATERSHED - North Shore Watershed; Cape Ann Sub-basin
SUPPLIER - Gloucester Department of Public Works
SOURCES - Babson Reservoir - .95 mgd
- Haskell Reservoir - .62 mgd
- Wallace Reservoir - .20 mgd
- Goose Cave Reservoir - .63 mgd
- Dikes Reservoir - .54 mgd
- Wells in Gloucester - .59 mgd
- Total safe yield - 3.53 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 4.34 mgd
-Maximum Daily - 7.97 mgd	-Maximum Daily - 8.07 mgd
Service Population - 28,250	Service Population - 29,500

Gloucester has had a supply shortage for a couple of years, since a state-ordered repair of the dam at Dikes Reservoir necessitated draining that reservoir. The situation was aggravated in 1978 by the dry weather, and several on-lot wells went dry in response to increased summer consumption. As a short-term solution, Gloucester bought water which was placed in a tank in the center of town; residents hauled the water home.

The Economic Development Administration (EDA) is funding an excavation project for Dikes Reservoir which will more than double its capacity (from 255 mg to 800 mg) but the project will not be completed for anpther 2 or 3 years. In the meantime, Gloucester is exploring the possibility of a new groundwater with an anticipated safe yield of 2 mgd.

The town would be interested in tapping into the proposed regional reservoir in Ipswich, were it to be constructed. System rehabilitation needs are estimated at $3 million, to replace 2 miles of 6" pipe with 12" pipe, clean and line 10 miles of mains, and stabilize pressure at a couple of the standpipes.

Gloucester's industry is not only water-intensive but requires high-quality water. Fish processing requires fresh water for cleaning the fish; salt water cannot be used. The industry has considered, but has yet to institute, recycling and reuse of its water. In the near future, however, the fish processors will be required to pre-treat their wastewater, since the new sewage treatment plant will not accept the wastes currently being discharged. This would seem to provide the incentive to institute recycling.

6. GREENFIELD

WATERSHED - Connecticut River; Deerfield River Sub-basin
SUPPLIER - Water Division of the DPW
SOURCES - Leyden Glen Reservoir, Green River, and Mill Brook Wells (3); total safe yield approximately 3.3 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 2.42 mgd	-Average Daily - 4.56 mgd
-Maximum Daily - 3.90 mgd	-Maxumum Daily - 9.12 mgd
Service Population - 11,000	Service Population - 19,000

Greenfield's water supply problems result from a shortage of supply and an inadequate distribution system. The town hopes to solve the latter problem first, feeling that it makes little sense to increase supplies unless the water can reliably be transferred to the users. Although the system is 100% metered, 20% of the public water supply is unaccounted for. System renovations would include renewing existing mains, adding new transmission mains, and increasing storage capacity within the system. The cost of the pipe-relining portion of the program has been estimated at $20-$30 thousand per year, over a five-year period.

In the short run, Greenfield feels it can curb demand in part by raising water rates. Presently, users are charged 50¢/100 cu.ft. for the first 2000 cu.ft.; 40¢/100 cu.ft. for the next 98,000 cu.ft.; 30¢/100 cu.ft. for the

next 100,000 cu.ft.; 20¢/100 cu.ft. for anything over 200,000 cu.ft.; they are billed twice yearly. The town also hopes to make its industrial users recirculate their cooling water. This attempt, if successful, could lead to substantial reductions in demand, for there are 16 industrial users on the system, three of which are major -- Lunt Silversmiths, Greenfield Tap and Die, and Millers Falls Tools.

Eventually the town will need a new reservoir. The one proposed would be on the Green River and have an estimated safe yield of 4.0 mgd; cost has been estimated at $10 million. They must institute watershed protection measures and acquire additional land to protect both present supplies and the proposed resevoir site.

7. HOLDEN

WATERSHED - Merrimack River Watershed; Nashua River Sub-basin
Wachusetts Reservoir Drainage
SUPPLIER - Holden Water Department
SOURCES - 5 town wells in Holden - 1.66 mgd; Muschopauge Pond, reservoir shared with Rutland, -.39 mgd depends on water level; 1 mgd puchased from Worcester, if not needed by Worcester

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 1.4 mgd	-Average Daily - 1.693 mgd *
-Maximum Daily - 2.05 mgd	-Maximum Daily - 2.54 mgd
Service Population - 12,200	Service Population - 13,658

* Holden projects 2.24 mgd

Holden is in an anomolous situation in that the Legislature, through various special acts, beginning in 1854 and extending through 1946, has granted water and water rights within Holden to the MDC and Worcester. These water rights involve five reservoirs: Kendall, Pine Hill, Quinapoxet and Holden 1&2, which consume 1/5 of the land area in Holden, and provide to the MDC and the Worcester DPW. The correspondent water, water rights and flowage to these reservoirs are protected by statute; consequently, Holden can use the land for passive recreation only and can not tap into any of the water flowing beneath this land. In addition, the Quabbin Aqueduct, which feeds the Wachusetts Reservoir located in the neighboring town of West Boylston, has established a green belt through the center of town.

Holden has five town wells -- Spring St., Mill St., Mason Rd., Quinapoxet Wells 1&2. The Mason Rd. well is the newest well having been brought on line in 1975. Holden has enough water to supply current users, provided that none of the wells go down, and the level of water stays high. The amount of water that can be drawn Muschopauge Pond in Rutland is regulated by the water level, if it is above 5 ft., Holden can draw 800,000 gpd, however, if there is a dry spell and the level falls below 5 ft., Holden can only draw 145,000 gpd. Similarly, the amount of water Holden may purchase from Worcester if the water is not needed to supply Worcester's "regular" customers. If, Holden and its neighboring communities have a dry summer, then Holden can not receive the water needed to provide for its customers, even with water bans in effect.

In recognition of the situation, Holden has taken several water conservation measures, including requiring that water conserving devices be installed in new senior citizen housing in town, and stipulating that all new construction will have these devices. They also have summer water bans and have in the last nine years changed their rate structure three times; their current rate is basically flat; $6.50 per quarter as a minimum, for 500/cu.ft. with a $.70/100 cu.ft. charge for water used in excess of the first 500 cu.ft. They are considering another increase to an ascending block format. Holden may have to consider

a building ban if no new water becomes available; they are currently promised to deliver an additional 100,000 gpd by 1980.

Several of the special acts do grant Holden certain rights to water in their sub-basin drainage. Chapter 488 of 1895, which established the original Metropolitan Water Works, grants Holden and several other northern Worcester county communities the water rights to the upper Nashua River. To use this water will, however, require a special act. Holden can not use much of the water in the town because it is part of the stream and tributary system flowing into the waters belonging to Worcester.

The options Holden is considering include tapping into the Quabbin Aqueduct which flows through the center of town, constructing a new reservoir for the use of the community, on land adjacent to an MDC reservoir whose water rights belong to hte MDC, and the possible development of some swamp land in the town. All alternatives would require costly treatment, and all will require a special act of the Legislature.

8. IPSWICH

WATERSHED - North Shore; Ipswich River Sub-basin
SUPPLIER - Ipswich Water Departmcnt
SOURCES - Dow Brook Reservoir - safe tield .4 mgd; wells in Ipswich - safe yield 1.4 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 1.838 mgd
-Maximum Daily - 2.196 mgd	-Maximum Daily - 4.136 mgd
Service Population - 11,800	Service Population - 14,200

The Town of Ipswich has within its borders one of the few good sites for a regional reservoir, designated as such by a 1970 study by the Water Resources Commission. Community residents have rejected the proposal, preferring to develop the site as a local reservoir.

The town has a seasonal water shortage, partly because the Ipswich River, a major recharge source for town wells, is over-pumped by upstream communities. Like many other North Shore communities, Ipswich institutes summer water bans on all non-essential uses.

Ipswich also has difficulties in maintaining its water system. The town manager, in a letter to this Commission, suggested that the state assist communities with leak detection and system rehabilitation to "provide some direct and immediate relief to residents." He added that "it is important to have grants for the enhancement of water supplies and the rehabilitation of existing water supplies

because of increased Federal mandates on the condition of water supplies." System rehabilitation represents a financial burden the town cannot bear alone, for water rates do not reflect (and therefore do not cover) maintenance costs.

The construction of a regional reservoir would confer benefits on Ipswich and 17 other communities, 6 of which are, like Ipswich, experiencing current deficits, and another 6 of which anticipate shortages by 1990. This resevoir is for some of these communities the only viable alternative, since the MDC is presently not an option. Sound resource management for the basin would indicate that a regional reservoir to meet future needs is the most sensible approach.

9. NEW BEDFORD

WATERSHED - South Shore Watershed; Buzzard's Bay Sub-basin
SUPPLIER - New Bedford Water Department
SOURCES - Lakeville Ponds - 11.5 mgd from Asawompsett Pond; 8.5 mgd from Little and Great Quittacas Ponds

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily -	-Average Daily - 19.08 mgd
-Maximum Daily -	-Maximum Daily - 26.33 mgd
Service Population - 100,345	Service Population - 91,600

The New Bedford Water Department operates a regional system which supplies Freetown and Acushnet fully, Dartmouth partially, and provides backup supplies for Fairhaven. It has a 68 mg. storage resevoir, and derives its water supplies from ponds in Lakeville; the Assawompsett, to which it shares rights with Taunton and Fall River, and Little and Great Quittacas Ponds. Fall River has never exercised its water rights, which were granted by an act of the Legislature in 1924. The water passes to New Bedford through Little Quittacas Pond, where a new treatment plant is presently being completed. The plant has a capacity of 45-60 mgd, and will probably be used for the treatment of iron, acid and bacteria.

Demand is projected to increase substantially by 1990, although service population is expected to decline, for 75% of total consumption is industrial (primarily fish processing).

There has been some voluntary conservation on both the industrial and domestic levels, but increased supplies will be necessary to meet the projected demands. New Bedford may attempt to acquire some of Fall River's unexercised rights to the Lakeville Ponds, or perhaps will resume use of an old resevoir in Acushnet, which is presently being used for recreation.

New Bedford is presently carrying out a ten-year system rehabilitation program which entails the building of a new water main and the relining of several old ones. It is a $2,000,000 program, 70% funded by H.U.D. Estimated loss from the system is about 5%; leaks are dealt with as they occur.

10. NORTH READING

WATERSHED - North Shore Watershed; Ipswich River Basin
SUPPLIER - North Reading DPW
SOURCES - 5 wells in North Reading - total safe yield of 1.7 mgd
Emergency connection to Andover - maximum of 324,000 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 1 mgd	-Average Daily - 1.647 mgd
-Maximum Daily - 2.5 mgd	-Maximum Daily - 3.294 mgd
Service Population - 12,400	Service population - 14,800

The town of North Reading has for some time been concerned about the adequacy of its water supplies. Presently the yield of its wells is decreasing, and the water quality, although it meets minimum standards, is not very good. It is treated to remove iron and manganese; the process entails formidable costs since it must be performed at each of four different well sites.

North Reading applied for water from the MDC in August 1976; the town sought to keep three wells operating and take one third of its supplies from MDC. The request was turned down because MDC, in light of its chronic demand/safe yield imbalance, felt it could not responsibly make such a committment. MDC advised the town to investigate alternatives for developing its own sources of supply, but voted to endorse enabling legislation to connect

North Reading to the MDC distribution in the event that feasible alternatives are not found.

The town has performed groundwater explorations, which have thus far turned up nothing. It has applied for funds for a reservoir; money might come from the Public Works Act Employment funds. The town has a right to 5 mgd from the Ipswich River in the months of November through April. This would give the proposed reservoir a safe yield of 4 mgd, enough to assure the town of water supply through 2020. North Reading has negotiated with Lynnfield about the possibility of sharing a reservoir, but it pears that Lynnfield would prefer to build its own reservoir if it can get federal funds.

North Reading has instituted summer water use restrictions for the past ten years. The system is 80% metered; water rates are a uniform 75¢/1000 gallons, and bills are sent out twice yearly. For each billing period there is a required minimum consumption of 30,000 gallons. Revenues go into a water budget, which is used for all maintenance and bonding.

11. STOUGHTON

WATERSHED - Charles/Mystic/Neponset River Watershed; Neponset Sub-basin
SUPPLIER - Stoughton Public Works Department
SOURCES - 5 wells in Stoughton - 3.07 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 2.17 mgd	-Average Daily - 3.787 mgd
-Maximum Daily - 3.07 mgd	-Maximum Daily - 6.910 mgd
Service Population - 25,717	Service Population - 33,750

Stoughton's inadequate water supply problem is severe and has progressed from bad to worse since 1949. New sources are needed to serve the growing pcpulstion and accomodate the town's present policy of encouraging commercial and industrial development.

A 1969 report by Camp, Dresser & McKee states that groundwater, Stoughton's only source of supply is depleted. A follow-up report in 1975 reaffirmed the water deficiency. A new study by the same firm has been commissioned to determine if an adequate groundwater supply of non-potable quality water is available for commercial and industrial use.

The town sought what can be seen as a possible solution to its problem. Legislation allowing mains to run through the Blue Hills Reservation with a possible MDC hook-up was passed in 1976. The town has built 24 inch mains to its borders in anticipation of this hook-up; however,

since the passage of this bill, a moratorium has been declared on all MDC expansion.

A dilemma exists. How can Stoughton expect economic growth without adequate water resources? Peter Griegos, the Town Planner states that "Economic growth is essential to stabilizing the tax rate". He also feels that growth should be planned and regulated; population should not exceed 32,000.

In August 1978, Governor Dukakis pledged his support to aid Stoughton with its water problem. Since then, the MDC has stated that it will allow up to 1 mgd to flow through the emergency pipe line that already exists between Canton and Stoughton. To date, agreements between Canton and the MDC have yet to be worked out, as are accords between Stoughton and Canton regarding allotment and compensation.

Although Stoughton has had water restrictions since 1949 (bans on car washing, lawn watering, etc.) and has established a Special Water Commission to study and make recommendations, a comprehensive water conservation program, essential to any solution of its water problems, has not yet been established.

12. LEE

WATERSHED - Housatonic River Watershed
SUPPLIER - Lee Water Department (also serves parts of Stockbridge and Lenoxdale)
SOURCES - Venetti Reservoir in Lee - safe yield .30 mgd
- Upper Reservoir in Lee
- Washington Mountain Brook
- Codding Brook Reservoir
- Total safe yield of sources - 1.0 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily	-Average Daily - 1.2 mgd
-Maximum Daily	-Maximum Daily - 2.66 mgd
Service Population - 6,480	Service Population - 6,498

Although the western part of the state is generally throught of as "water rich," the problems of supply are complicated by the geography of the region. Water cannot be pumped economically over great variations in elevation, so many western communities must rely on essentially local water resources.

Lee has been pursuing a water supply project over the past twelve years as part of a Soil Conservation Service PL-566 flood control project on Washington Mountain Brook. Three impoundments have been proposed: Washington Mountain Lake; October Lake; and School House Lake. The first two impoundments are part of the flood control project, and School House Lake is solely for water supply, yielding 1.4 mgd, enough to satisfy Lee's 50 year needs. October Lake can also be used for water supply, yielding 1.0 mgd.

The Water Resources Commission, which must approve the expenditure of state funds for PL-566 projects, has questioned the need for all three impoundments. In addition, the WRC has asked that all groundwater alternatives, which might be far less costly, be explored. To this end, the WRC has authorized drilling contracts for work in the Woods Pond area of Lee. Work was scheduled to begin in mid December, 1978.

The Lenoxdale aquifer, immediately south of Woods Pond, has been estimated to have a potential yield of 4 to 5 mgd by a Geraghty and Miller study in 1972. Since development of this source could also serve Lenox, which has a projected 1990 deficit of .46 mgd, there is good reason to pursue its potential. However, Lee and Lenox have not been able to agree on a joint water supply development program, and there is pressure within Lee for the surface impoundment alternative since recreational benefits would also result.

A related issue involves possible contamination by PCB's from the nearby General Electric plant. Until recently, ground disposal of electrical devices containing PCBs was practiced at the plant. There is now a fear that the groundwater in Lee may be contaminated. Measurement of PCB concentrations is very difficult since the levels naturally fluctuate widely. GE now disposes of its PCB wastes by incineration, but this has posed a new potential threat of airborne contamination. PCB concentrations have been

detected in one of Lee's surface water reservoirs. This quality issue may restrict the water supply alternatives available to Lee. A definitive determination of the PCB contamination issue has not yet been made.

13. BEDFORD

WATERSHED - Merrimack River; Concord River Sub-basin
SUPPLIER - Bedford Water Department
SOURCES - Wells in Bedford - safe yield 1.36 mgd
- Wells in Concord - safe yield .40 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - **	-Average Daily - 3.042 mgd
-Maximum Daily - na	-Maximum Daily - 5.89 mgd
Service Population - 15,100	Service Population - 19,750

**figure not available, but known to be exceeding safe yield

The town of Bedford has experienced a substantial water supply shortage in recent years, as average daily consumption has exceeded the safe yield of its limited groundwater supplies. In December 1977, Bedford received permission to purchase up to 500,000 gallons of MDC water through a connection with the town of Lexington, on an emergency basis from May through October. The anticipated emergency became a crisis, however, in late May 1978 when four of Bedford's wells were found to be contaminated with toxic chemicals.

The contaminants, which include dioxane and trichloroethylene, have infiltrated the recharges areas of the wells, resulting in recorded concentrations well above the recommended health limits of 10 and 20 parts per million, respectively. The sources of these contaminants have not been positively identified, though a local industry located near the recharge area uses dioxane in its processing and is sus-

pected as the source. The source of the trichlorooethylene is more difficult to determine. It may be coming from a sewer line which is suspected of leaking, but it could also be from an illegal discharge upstream on the Shawsheen River.

State and local officials do not know how long the contamination has existed. Its discovery was completely accidental, the result of an engineer testing Bedford's water for a graduate-school paper he was writing. On learning of the contamination, Bedford officials closed the wells and notified the state Department of Environmental Quality Engineering. DEQE reaffirmed the well closings and began investigations with the town to determine the sources of the problem. The wells cannot be reactivated until the sources are identified and controlled, and until concentrations in the wells fall below health standards.

On September 28, 1978, DEQE recommended that the town hire a consulting engineer and that BASF Industries also engage an engineer to work on the problem. The state has been collecting samples and testing them for the town, but limitations in state testing facilities preclude an adequate testing program and private laboratories will be used as well.

The results of this crisis have been costly for Bedford. First, the contaminants are suspected carcinogens and the

potential health impacts could be severe. Second, the cost to the town has been substantial. The wholesale cost of MDC water is $240 per million gallons to its member communities, but Bedford is forced to pay $601 per million gallons to Lexington for its emergency supplies. This has amounted to approximately $1200 per day in additional expense for Bedford. In addition, Bedford, has been forced to declare a moratorium on all new hookups, bans on non-essential uses, and adoption of ascending block rate water rate charges.

A further implication of Bedford's water supply crisis is growing pressure to join the already strained MDC system. Even if the polluted wells can be restored to service, Bedford will still face substantial shortages. The town is exploring additional groundwater supplies, but due to the geological character of the area, no new sources are likely to be found.

14. FALL RIVER

WATERSHED - Narragansett Bay Watershed; Main River Sub-basin
SUPPLIER - Fall River Water Department
SOURCES - North Watuppa Pond - 9.0 mgd; Copicut Reservoir - 6.5 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 16.66 mgd	-Average Daily - 11.735 mgd
-Maximum Daily -	-Maximum Daily - 17.368 mgd
Service Population - 100,339	Service Population - 88,700

Fall River's water supply is derived from the North Watuppa Pond, backed up by the Copicut Reservoir, combined safe yield is approximately 16.0 mgd (city's projection). Chapter 400 of 1924 granted 11.5 mgd from Long Pond in Lakeville as allocated rights, Fall River has not used this water; however, the statutue still exists. Currently, Fall River is consuming 16.66 mgd; this has not been a prblem due primarily to the fact that the years have been relatively "wet."

Although a sharp decline in the city's population is projected, it will need additional supplies if it is to act as the center of a regional water supply system, a role that the city has gradually been asuming. Fall River has a long standing agreement to supply water to North Tiverton, R.I. and has been asked to consider expanding that supply to include Tiverton as well. Three years ago an agreement was

signed with Somerset, MA and the New England Power Company to supply them with water. Freetown and the Polaroid Corp. are negotiating with Fall River currently. The neighboring town of Westport recently had an engineering study completed which indicated that the most economical route to augment its water supply is to tie in with Fall River.

South Watuppa Pond has the capacity of providing additional water, were it not so badly polluted. It has eutrophied for many years and is approaching a state of advanced eutrophication. Copper sulfate was used, until 2 years ago, to combat the algae; consequently copper concentrations are probably too high. Also, until quite recnetly, Bleachery Ponds and Sucker Brook carried industrial sanitary wastes from an aluminum processing plant into the pond. The Mayor of Fall River told Federal officials Dec. 4 in the offices of EOEA that the city and its neighbors would like to see the pond restored to potable water supply capacity; however, federal and state funds and assistance would be necessary to complete the task.

Additionally, Fall River needs protection assistance for the North Watuppa and Copicut Reservoir, primarily from salt, gasoline and chemicals. The ponds are surrounded by reservations; however, chloride concentrations in North Watuppa Pond have doubled since the construction of Routes 24 and I-95. The 208 study suggests that the city either prohibit or establish a permit system for gasoline, salt &

chemical storage, landfills and large septic systems.

Fall River's distribution system is 100 years old and badly in need of renovation and rehabilitation. The city has for five years been cleaning and cement lining water mains at a rate of 18,000 - 20,000 feet a year; this is the only amount they can afford at this time. There are over 120 miles of mains to be done, so it would take 35 years if costs were stabilized and they were to continue at the current rate. Costs have recently taken a large jump from $16/foot to $40/foot, according to the Mayor's statement. The statement goes on to say that "Obviously only the Federal government can supply the funds required for a job of this magnitude" and concludes that

> "Present and future water supply and distirbution problems can only be addressed by adopting a spirit of cooperation amongst Federal, State and Local governments. Effective and economical regionalizations will be realized only when the federal government financially assists older urban areas to update their water systems and clean and preserve all available water supplies"

15. GOSHEN

WATERSHED - Connecticut River; Westfield River Sub-basin
SOURCE - Private wells

Goshen is a rural community of 629 people, located on Route 9 (called Main Street as it passes through Goshen) approximately halfway between Northampton and Pittsfield. The town is completely served by private artesian wells with depths of 100 - 200 feet.

In 1967, residents in the highway area began to notice a bad taste in their well water, which was eventually discovered to be due to chloride contamination from road salting on Route 9. Chloride levels ranging from 300 - 2,675 parts per million were found in water from wells near the highway; the natural level of chloride in Goshen's water is about 5 ppm. The contamination has forces numerous families, and the town school, to close down their wells and either buy bottled water or carry water taken from some "safe" location in town. In many still-usuable wells, pumps and pipes have been severely corroded by the salt; in some homes, furnaces have had to be replaced.

The DPW attempted to remedy the problem back in 1972, by installing a special drainage system designed to divert

the water and salt from Route 9 away from the wells. Salt levels have, however, remained high. Town officials and residents are by now quite frustrated, and recently eight families have started legal proceedings against the state, for not taking actions to remedy the situation.

16. LYNN

WATERSHED - North Shore Watershed
SUPPLIER - Lynn Department of Public Works
SOURCES - Hawkes Pond in Lynn
- Walden Pond in Lynn
- Birch Pond in Lynn
- Breeds Pond in Lynn
- Diversion from Ipswich River in Reading
- Saugus River in Lynnfield
- Total safe yield - 17.0 mgd
- additionally, the MDC supplies water for General Electric

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily -	-Average Daily - 15.8 mgd
-Maximum Daily -	-Maximum Daily - 25.1 mgd
Service Population - 90,000	Service Population - 89,700

The City of Lynn has had a serious problem with the bacterial quality of its water for many years. Portions of its water supply come from the badly polluted Saugus River, the relatively pure Ipswich River, and from four ponds straddling the Lynn-Saugus border. Both rivers and two of the ponds contain high salt levels, and pollutants in the Saugus River source demand further attention.

The Department of Environmental Quality Engineering (DEQE) records indicate that the Lynn public water supply system has failed to meet bacteriological standards at least three months in every year from 1962 to 1975. In 1976, Lynn's water supply failed to meet bacteriological standards for 8 months of the year, and more recent records show persistence of the problem.

On June 20, 1977, DEQE issued an order requiring a variety of short and long term actions by the City to remedy the water quality problem. Short-term actions include improved chlorination equipment and a new alarm system. Long term improvements include construction of a new water purification plant, cleaning and relining of approximately 10 miles of existing mains, and covering of the low service reservoir.

The total cost of the required improvements is estimated to be $43 million; $14 million for design and construction of the treatment plant, $20 million for the renovation of the city's distribution system, and $9 million for a 48" pipeline from the Ipswich River to Hawkes Pond. Lynn has an assessed valuation of $580 million and a present indebtedness of $28 million. It is in no position to fund the needed improvements despite the fact that water rates were doubled in March 1978. The passage of Chapter 406 of the Acts of 1978 provides 50% state funding for the treatment plant, but other renovation costs total $29 million, for which no state or federal assistance is currently available.

17. PITTSFIELD

WATERSHED - Housatonic River Watershed
SUPPLIER - Pittsfield Water Department
SOURCES - Millbrook Reservoir system, consisting of Farnham and Sandwash Reservoirs in Washington
-Cleveland Brook Reservoir in Hinsdale
-Ashley Reservoir system, consisting of Ashley Lake in Washington, Sackett Reservoirs in Hinsdale, and Lower Ashley Reservoir in Dalton
-Total safe yield is 14.7 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily -	-Average Daily - 13.85 mgd
-Maximum Daily -	-Maximum Daily - 17.45 mgd
Service Population - 55,194	Service Population - 52,965

Pittsfield relies on surface water supplies from Farnham and Sandwash Reservoirs in Washington, Cleveland Brook Reservoir in Hinsdale, Ashley Lake in Washington, Sackett Reservoirs in Hinsdale, and Lower Ashley Reservoir in Dalton. It owns all of its reservoirs, along with adequate watershed protection area for each. In exchange for the right to develop Cleveland Reservoir, Pittsfield supplies up to 46 mg/month to Dalton for free -- this provision was included in the enabling legislation for the development of the reservoir. Dalton buys water from Pittsfield over and above this amount. Pittsfield also sells water from Farnham Reservoir to Lenox.

The water supply is treated with chlorine, which is added directly to surface supplies, since the city

lines are more than 50 years and some are 75 to 100 years old. Since the water is chlorinated prior to entering the pipes, it is often insufficient to disinfect the pipes.

The city needs both a treatment and a system rehabilitation program. Costs for the treatment plant have been estimated at $23 million. The city does not have an accurate engineering cost estimate for the rehabilitation of the whole system; this figure is probably impossible to obtain until the actual work is begun. Pittsfield needs state assistance to begin this program.

18. PROVINCETOWN

WATERSHED - Cape Cod/Islands Watershed
SUPPLIER - Provincetown Water Department
SOURCES - Wells in North Truro - 3.0 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - .75 mgd	-Average Daily - 2.936 mgd
summer - 1,5 mgd	
-Maximum Daily - 2.8 mgd	-Maximum Daily - 6.166 mgd
Service Population 18,432	Service Population 23,060

Large numbers of tourists strain Provincetown's water supply each summer. The town derives its extra supply from Truro, its immediate neighbor. Although new potential sources have been identified in the Cape Cod National Seashore in Truro, these supplies may not be made available to Provincetown. The Cape Cod National Seashore does not want to establish a precedent for allowing unlimited use of National Park Service Resources. The town of Truro is fearful that use of the water source would draw from its own resident's supply.

To compound this problem, a gasoline storage tank leaked gasoline into the ground in an area 600 ft. from the South Hollow well field, part of the Provincetown system of wells. Although the well field itself has not become contaminated, the well has been closed so that pumping would not pull the gasoline into the water supply.

Consultants to Provincetown have recommended that the gasoline be pumped out and that remaining gasoline adhering to the surrounding soil particles may be removed by a bio-reclamation process; a process in which nutrients are introduced into the soil to consume and digest the gasoline.

Provincetown selectmen have approved town appropriations totalling $45,000 and have authorized the borrowing of an additional $670,000 from the federal government to cover reclamation costs. However, there is no guarentee that the process will be successful.

The town manager of Provincetown has asked for legislation to prevent future contamination of wellfields by gasoline storage accidents.

19. READING

WATERSHED - Charles/Mystic/Neponset River Watershed; Mystic River Sub-basin
SUPPLIER - Reading Department of Public Works
SOURCES - Wells in North Reading : Tubular Wells #2&3 - 1.4 mgd; B-Line Well - .7 mgd; Well # 15- .7 mgd; Well # 13 - 1.0 mgd; Well # 66.8 - .7 mgd; Town Forest - 2.0 mgd (Revay 1 & 2 shut down)

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 3.26 mgd*	-Average Daily - 3.726 mgd
-Maximum Daily - 4.91 mgd*	-Maximum Daily - 6.955 mgd
Service Population 24,250	Service Population 29,500

*These figures obtained from a Weston & Sampson Engineering study, not from the MWSP

Reading has had to stop drawing water from Revay Wells # 1 & 2 due to high sodium counts believed to be caused by road salt storage and use on the state highways - Route 93 and Route 128. In addition, the other town wells have high chemical counts which require extensive treatment in order to meet many of the safe drinking water standards established by EOEA.

The treatment process in turn adds chemicals; Chlorine, Ferret Chloride and Sodium Hyper Chloride, this is to treat for the high iron and manganese in the water. The resultant water has a high sodium count, unsafe for the "at risk population". The town is uncomfortable with this and is trying to improve the situation. In 1976, Reading commisisoned the engineering firm of Weston & Sampson to study and make

recommendations regarding the water supply system in Reading. The recommendations outlined in the report are being followed by the town, and it expects to be able to correct the quality problems in the near future.

The anticipated costs for improvement of the Reading water supply system, including system rehabilitation as well as treatment plant improvements, have been broken down into three phases: Phase I - $3,052,600, Phase II - $2,060,000, Phase III - $1,218,800, for a total cost of $6,330,000. Work has already begun, and it is expected that the program will take thirty-five years to complete.

20. TAUNTON

WATERSHED - Taunton River Watershed
SUPPLIER - Taunton Water Department
SOURCES - Lakeville Pons Complex, Assawompset Pond, Posksha Pond, Long Pond - 8.0 mgd, Taunton River - 1.50 mgd; private wells

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 6.5 mgd	-Average Daily - 6.877 mgd
-Maximum Daily - na	-Maximum Daily - 9.972 mgd
Service Population 42,148	Service Population 44,000

One of the few communities to have issued a boil order for its water, Taunton is facing a massive construction project for its water purification plant. A boil order is issued by DEQE when the coliform counts get too high in the water for safe consumption by the residents. The testing process is elaborate and requires five days before the order is issued, so as to insure that the counts are not merely an anomoly.

Taunton derives its water from the Lakeville Ponds complex, and Lakeville has expressed concern over the quality of the water in this complex. Chapter 406 of 1978 is seen as one possible solution to the increased financial burden faced by Taunton, at least partially. Additionally, however, Taunton needs assistance for rehabilitation and repair of its water supply system. Taunton serves as one of the six regional suppliers, serving the neighboring towns of Raynham and Dighton, and thus seeks state assitance in

the aforementioned areas in order that it may be able to insure an adequate supply of potable water to its customers.

Taunton is not in a unique position in that many of the older communities of the Commonwealth face water quality problems due to older systems and massive distribution trunk lines. The mayor's office has echoed the sentiments of others in that the financial burden of system rehabilitation is too great for the city to absorb alone.

21. WESTON

WATERSHED - Charles/Mystic/Neponset River Watershed; Charles Sub-basin
SUPPLIER - Weston Water Department
SOURCES - Wells in Weston - 2.2 mgd; MDC - 2.5 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 1.747 mgd
-Maximum Daily - na	-Maximum Daily - 3.320 mgd
Service Population - 12,000	Service Population - 14,000

Although Weston was capable of meeting its water supply needs it elected to join the MDC Water District in 1966 in anticipation of its future growth needs; the MDC then began to supply one third of Weston's water needs.

Steadily rising chloride levels in the 1960's, presumed to be caused by road salting of state highways (Weston is located at the junction of I-90 (Mass Pike) and Route 128) forced the shut-down of two of the three town wells in 1972. At that time chloride samples showed levels between 350 - 400 ppm; medical recommendations for suggested levels of chlorides for the "at risk population" is 20 ppm. This figure has been adopted as the standard by EOEA.

Nickerson Field and Fitzgerald wells remain closed; chloride levels remain above healthful standards.

22. BURLINGTON

WATERSHED - Merrimack River Watershed; Main River Sub-basin
SUPPLIER - Burlington Water & Sewer District
SOURCES - Shawsheen River - 3.0 mgd; Wells in Lexington - 4.66 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 4.624 mgd
-Maximum Daily - na	-Maximum Daily - 8.863 mgd
Service Population 27,250	Service Population 34,250

De-icing chemicals used to keep Route 128 free of snow and ice along with an uncovered salt storage pile approximately 400 ft. from the well field were important factors leading to the high chloride concentration in Burlington's water supply.

When chloride levels reached 283 ppm in 1970, Burlington, upon the recommendations of their consultants, Whitman and Howard, Inc., banned the use of salt by its highway department. In their report Report relative to Salt Contamination of Existing Well Supplies, Town of Burlington", Whitman and Howard state that the automobile accident rate declined when the "no salt" policy was instituted. In fact, in 1970, the year no salt was used, the total number of automobile accidents was 981, which is considerably less than in 1969 when the total number of accidents was 1061. The Burlington Department of Public Works confirmed these findings and reported that the accident rate to date has remained on the low side.

The ban on using salt on public highways was rescinded in 1972, but by-laws in effect restrict the use of salt by the highway department to 2,000 tons per year. The department has not used more than 1,400 tons per winter and during the 77-78 season used only 600 tons of salt.

By-laws also exist which ban the use of salt by Burlington residents on private property. Each year the Burlington Board of Selectmen and the Burlington Board of Public Works send out the following notice:

> This is to remind you that the use of chlorides (road salt) within the Town limits for the control of snow and ice on both public and private parking areas and roadways is prohibited. We anticipate your strict adherence of this By-law.

23. HANOVER

WATERSHED - South Shore Watershed; Main River Sub-basin
SUPPLIER - Hanover Public Works Department
SOURCES - 7 wells in Hanover - 2.74 mgd due to limited capacity of treatment plant, potential 3.37 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - 1.2 mgd	-Average Daily - 1.537 mgd
-Maximum Daily - 2.8 mgd	-Maximum Daily - 3.028 mgd
Service Population - 11,400	Service Population - 13,500

The town of Hanover has long experienced water supply problems resulting from the lack of adequate supplies to meet the demand for water accompanying the rapid population growth that has taken place in the town since the 1950's. The town voted in 1973 to meter all water services in town, and in that same year completed the construction of two new wells in the Pond Street area. The treatment plant at Pond Street, completed in 1974, has a capacity of 2.0 mgd, which keeps the potential safe yield of the three wells (3.9) from being realized. Since growth pressures continue, and prospects for additional supplies are dim, the town is having a study done to determine a means for protecting existing groundwater supplies.

On February 1, 1978, the Hanover Board of Public Works declared that a state of emergency existed with regard to the protection of water supply and quality affecting public health, safety and welfare, and declared a 2 year moratorium on new construction in the area of Route 53 in Hanover.

The Board's declaration listed the reasons for the ban. A primary consideration is that supplies are simply inadequate to support further development, and there are no immediately usable supplies in areas unaffected by Route 53. Moreover, all of the town's existing wells are within 2800 feet of the highway, close enough to be directly affected by drainage from the highway. New drainage facilities must be constructed to protect the wellfields. Proof of the danger to the wells is seen in the fact that, in 1969, the town had to eliminate open road salt storage in areas near the wells, for it was found that a salt storage facility was causing chloride contamination in wells 4,000 feet away.

The water mains serving the Route 53 area would not be able to handle additional water, even if it were available. The distribution system was installed in 1930; the mains in the Route 53 area are only eight inches in diameter and deterioration has lowered their carrying capacity to half that of a new eight inch main. Consultants to the town recommend that this main be supplemented with a sixteen-inch main, to satisfy present and projected 1990 demands, and assure adequate flow for fire-fighting in the Hanover Mall area.

The town has recently appropriated $40,000 for two on-going studies -- one is the groundwater protection study mentioned above, the other, an evaluation of all aspects of

of the present water supply situation and development of a program to assure ample water supplies through 1990.

24. LAKEVILLE

WATERSHED - Taunton River Watershed
SUPPLIER - Resort Supply, Inc.
SOURCE - Wells in Lakeville - safe yield .28 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - .423 mgd
-Maximum Daily - na	-Maximum Daily - 1.066 mgd
Service Population - 5,118	Service Population - 7,250

The town of Lakeville contains a vast complex of five ponds - Long, Assawompsett, Pocksha, Great Quittacas and Little Quittacas -- which provide water supply to Fall River, Taunton and New Bedford, who in turn supply water to several other nearby communities. The ponds have a total drainage area of 47.2 square miles, a maximum storage capacity of 20.6 million gallons, and a total safe yield of 30.8 mgd.

The above communities were granted rights to the Lakeville Ponds by special acts of the legislature. Chapter 345 of the Acts of 1894 authorized New Bedford to take the Little and Great Quittacas ponds. Chapter 400 of the Acts of 1924 allocated the waters of Long, Assawompsett and Pocksha ponds to Fall River, New Bedford and Taunton, with the following stipulations:

-Fall River is limited to 11.5 mgd from Long Pond; the water not required is to pass into Assawompsett

for use by New Bedford and Taunton. Any one of the cities may appeal to the Department of Public Health for a reapportionment, if it becomes necessary.

-Lakeville and Freetown can draw water directly from Assawompsett and Pocksha Ponds, and, if Fall River exercises its right to Long Pond, they are authorized to draw directly from Long Pond.

-New Bedford is allocated 11.5 mgd from Assawompsett and Pocksha.

-Taunton is allocated 8.0 from Assawompsett and Pocksha.

-Upon application to either New Bedford or Taunton, water can be furnished to Lakeville, Middleborough, Acushnet, Dartmouth, Raynham, Fairhaven, Dighton, Berkley, Freetown, Carver, Wareham, Marion, Rochester or Mattapoisett.

-If Fall River draws from Long Pond, it may furnish water to Lakeville, Freetown, Swansea, Somerset or Westport.

Altogether, this complicated system of allocations potentially exceeds the safe yield of the Lakeville Ponds system. Fall River, however, has not used its 11.5 mgd allocation and has no immediate plans to do so. New Bedford is exercising its right, and supplies water in turn to Acushnet, Dartmouth, Fairhaven and Freetown.

A statement submitted to this Commission by the Lakeville Board of Selectmen noted that "There would seem to be a moral obligation of municipalities benefiting from natural resources such as water to share in the responsibilities of preserving these resources."

25. LEOMINSTER

WATERSHED - Merrimack River Basin; Nashua Sub-basin
SUPPLIER - Leominster Water Department
SOURCES - Fall Brook Reservoir - 1.2 mgd; Simons Pond, Fitchburg - 3.49 mgd; Distributing Reservoir-1.1 mgd; Wells in Leominster - 1.2 mgd; Wells in Fitchburg - .65 mgd; MDC - 5.0 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 13.378 mgd
-Maximum Daily - na	-Maximum Daily - 19.917 mgd
Service Population - 32,790	Service Population - 45,164

Leominster's supply is in quite good shape in terms of demands placed upon the system. However, the director of the Leominster DPW has expressed some fear about the protection of the reservoirs and wells.

Leominster's supply lies very close to some rather major highways -- Route 2, Route 117, Route 12 and Route 61. The drainage systems for these roads need improvement so as to facilitate better protection by the city of the recharge areas from road runoff. All water in Leominster is treated before going through the distribution system.

The distribution system is in the process of being cleaned and relined in an effort to continue to provide Leominster residents with good water. Annual costs for this current program average approximately $300,000/year.

Leominster estimates that an additional 40 miles of pipe must be cleaned and relined in order to avoid excessive contamination from encrustation within the pipes.

The city would like to protect current supplies which, it feels, will require an extensive capital outlay in order to completely rehabilitate its distribution system.

26. PEPPERELL

WATERSHED - Merrimack River; Nashua River Sub-basin
SUPPLIER - Pepperell Water Department
SOURCE - Wells in Pepperell - safe yield 2.12 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - 1.216 mgd
-Maximum Daily - na	-Maximum Daily - 2.101 mgd
Service Population -5,895	Service Population - 9,206

The cases of two wells in Pepperell illustrate the need for protection of recharge areas for wells. To build its Jersey Street well, the town in the early 70's acquired 18.6 acres of land, taking it by eminent domain since a purchase price could not be agreed upon. The former owner, operator of a nearby sand and gravel business, was dissatisfied with the purchase price and sued the town for more money. He also continued to remove trees and gravel from land as close to 400 feet from the well; the town tried, unsuccessfuly, to get a court order to stop him.

The well yields approximately .5 mgd, and is recharged by a thick gravel deposit nearby, which is covered with trees. The gravel serves to purify the water and prevent direct evaporation -- if the gravel is removed, a greater amount of water would be lost to evaporation, especially during the summer months.

The trees, by breaking up direct rainfall, allow the water to enter the ground more slowly and evenly. They also limit the depth of frost penetration so that in the spring more snow melt can soak into the ground. Removal of the trees and gravel would inevitably lower the yield of well. Although the Department of Public Health requires protection of aquifers only within 400 feet of municipal wells, a hydrologic study determined that the well's cone of influence (ie. the area from which its water is drawn) extends alomost 1,000 feet from the well.

Around the same time the town became concerned about the Jersey Street well, proposals for new housing with on-site sewage disposal near the other town well bacame a cause of concern. The Board of Selectmen declared a moratorium on housing construction near the two wells while a study of the effects of the construction was conducted. The cone of influence of the Bemis Street well was found to extend beyond 1,000 feet.

The end result of this was a new zoning by-law, passed by the town at a special town meeting on December 10, 1973. It states that "No use that involved human occupancy, employment or the keeping of animals; or the exterior, uncovered storage of any leachate materials, or or any other use which causes the discharge of sewage,

wastes, chemical compounds, decayed matter or other similar substances shall be permitted within 1400 feet of any public well field or water supply source..." (source - Groundwater and Groundwater Law in Massachusetts, pp. 24-25)

27. SALISBURY

WATERSHED - Merrimack River Watershed
SUPPLIER - Salisbury Water Supply Company
Ring's Island Water District
SOURCES - Wells in Salisbury - safe yield 3.2 mgd

USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily	-Average Daily - .77 mgd
-Maximum Daily	-Maximum Daily - n.a.
Service Population - 4,179	Service Population - 8,701

Salisbury is situated on the northern coast of Massachusetts directly across the border from Seabrook, New Hampshire. In the summer, its population expands to around 15,000 with tourists and beach users. The town is currently under a court order to construct a sewage treatment facility because of the dumping of raw wastes from beach homes into the Black Rock Creek and the failure of up to 200 private septic systems. Most of the town is very close to the water table because of its location in an estuary.

Current supplies are more than adequate to meet projected 1990 demands based on population estimates from the Massachusetts Office of State Planning. Earlier engineering studies, however, projected a deficit by 1990 based on much greater population growth.

The town has two major concerns about the future adequacy of its water supply. First, the town of Seabrook has wells located less than one mile from the Salisbury wells. Demand

in Seabrook has risen dramatically due to consumption associated with the construction of the nuclear power plant there, and the level of Salisbury's wells has dropped. There is a fear that unregulated competition for water in the same aquifer could lead to future drought.

The second issue also involves diminished yields from the wells and is part of a quality issue. The treatment plant initially proposed for Salisbury was a traditional facility which would have diverted the waste flows out of the watershed into the ocean. The existing septic systems return water to the ground and thus help to recharge the groundwater supply. The Chicago engineering firm of Shaefer and Roland has proposed an innovative land application treatment process which would retain the benefits of groundwater recharge and be far less expensive. Salisbury is now waiting for a decision from the state on which alternative to develop.

Regardless of the treatment alternative selected, the issue of competition between Salisbury and Seabrook for the same groundwater will remain. It is complicated, of course, by its interstate nature.

28. SHIRLEY

WATERSHED - Merrimack River Watershed; Nashua River Sub-basin
SUPPLIER - Shirley Village Water District
SOURCES - Wells in Shirley - 1.25 mgd
USAGE

Present Consumption	Projected 1990 Consumption
-Average Daily - na	-Average Daily - .322 mgd
-Maximum Daily - na	-Maximum Daily - .525 mgd
Service Population - 3,605	Service Population - 4,474

Shirley is located in the north central part of the Commonwealth and is situated over a large aquifer created by the last glacier. The town has had various supply problems ranging from pollution of a town well by an accidental fire in a pesticide storage facility to pollution of a well due to faulty septic system management.* For the most part however, Shirley and its active Conservation Commission have managed to protect the water supply and recharge area well.

However, the geology of the land in Shirley lends itself to sand and gravel mining. This in turn has plunged the town into the midst of a court case to protect its wetlands. Shirley's Conservation Commission contends that the proposed mining operations of the Keating Gravel Company will significantly alter the town wetlands and subsequently alter the town recharge area thus affecting the town water supply. The company contends that the Conservation Commission is outside the letter of the law of the

Wetlands Protection Act and has countersued the town.

According to consultants for the town, the hydro-geology of the area is such that the water supply could be threatened if the mining operations were not strictly curtailed. Current town by-laws indicate that gravel companies may operate within the town but restrict the amount to be removed to 5,000 cu.ft. of sand or gravel. There are other companies in Shirley operating under this restraint, however, the Keating Company wants to operate under a permit issued prior to the enactment of the by-law, the previous permit grants them unlimited gravel and sand.

The Conservation Commission has gone to great lengths to prepare a very extensive Order of Conditions in accordance with the Wetlands Protection Act and are hopeful of a peaceful resolution to the problem. The future of Shirley's water supply may well rest on the result of the case.

* Massachusetts Audobon Society Newsletter, December 6, 1978 p. 6

APPENDIX 7.

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ABSORPTION - The penetration of a substance into or through another; assimilation.

ACTIVATED CARBON - A highly absorbant form of carbon used to remove dissolved organic contaminants in advanced wastewater treatment; required by the Safe Drinking Water Act for municipal supplies when synthetic organics are present.

ACTIVATED SLUDGE PROCESS - A biological treatment process in which biologically active sludge is agitated and aerated with influent wastewater to hasten the breakdown of organic matter.

ADVANCED WASTEWATER TREATMENT - Various processes used in addition to secondary treatment, including coagulation- sedimentation or electrodialysis, and adsorption which remove phosphorous nitrogen, and trace metals, and a high percentage of suspended and dissolved solids.

AERATED ZONE - The zone of the earth's surface which filters, but does not retain, water as it seeps through the saturated zone.

AERATION - A mechanical process of being supplied or impregnated with air. A wastewater treatment process to increase the dissolved oxygen levels that foster biological and chemical purification.

AEROBIC - Pertaining to the presence of, or need of, oxygen.

ALGAL BLOOM - Large masses of algae growth on or near the surface of lakes, streams, or ponds.

ANADROMOUS - A term applied to fish such as salmon, shad and alewife that travel from salt to fresh water to spawn. These fish are important in that their presence or absence is used as a measure of water quality.

APAC - Areawide Planning Advisory Committee

APPROPRIATIVE WATER RIGHTS - Acquired only by the diversion of water from its course and applying it to a beneficial use. Under this system, an earlier acquired right has priority over later rights. In the event of a shortage, the holder of the oldest right is the first entitled to a full delivery of his appropriated water, then the next oldest, until the supply is exhausted. An appropriative right is independent of the location of the user's land to the water diverted, as opposed to riparian rights; applied primarily in the Western states.

AQUEDUCT - A large pipe or conduit designed to bring water from a distant source.

AQUIFER - A subsurface strata of gravel, sand, or porous rock that carries or holds water.

ARTESIAN AQUIFER - Characterized by water at a pressure greater than atmospheric; this causes the static water level in a well tapping this type of aquifer to rise above the level of the water yielding layer. If pressure is sufficient, the well may flow freely at the surface, without any pumping.

ASSIMILATIVE CAPACITY - The capacity of a natural body of water to receive: a) wastewaters, without deleterious effects; b) toxic materials, without damage to aquatic life or humans who consume the water; and c) BOD, within prescribed dissolved oxygen limits.

BENEFIT - COST ANALYSIS - Economic analysis of a project or program which yields a ration between anticipated benefits and costs, thus revealing the relative economic efficiency of the project.

BENTHOS - Followers of the English philosopher, economist and jurist Jeremy Bentham (1748-1832); Also a collective name for all organisms which inhabit the bottom sediments of a water body.

BOD - A measure of the amount of oxygen consumed in biological processes that break down organic matter in water; a measure of the organic pollutant load. Biological Oxygen Demand.

CAC - Citizens Advisory Committee - referring in this case, to the Connecticut River Valley group working on the EIR.

CESSPOOL - A deep hole or pit in the ground, usually covered, to receive drainage or sewage from sinks, toilets, etc.

CHLORINATION - The addition of chlorine to water for disinfection or oxidation of undesirable compounds.

CLEAN WATERS ACT OF MASSACHUSETTS - A statute enacted in the 1966 legislative session establishing a Division of Water Pollution Control under the Water Resources Commission. Part of Chapter 21 of the MGL, Sections 26 - 53 inclusive.

COD - Chemical Oxygen Demand. A measure of the oxygen-consuming capacity of organic and inorganic matter present in water or waste water.

COLIFORM BACTERIA - See Fecal Coliform Bacteria

COLLECTING SYSTEM - A system of conduits (canals, ditches, pipelines, tunnels) used to carry water supply obtained from several different sources, such as different streams, to a common point. This point may be a reservoir, the intake of the main conduit, or the intake of the distribution system.

COMBINED SEWER - Sewer systems that collect both municipal wastewater and stormwater runoff.

COMMUNITION - Mechanical cutting and shredding of wastewater solids.

CONSUMPTIVE WATER USES - Water uses resulting in a large proportion of loss to the atmosphere by evapotranspiration, e.g. irrigation.

CZM - Coastal Zone Management; in Massachusetts under EOEA: Federal Coastal Zone Management Act of 1972 PL

DESALINIZATION - Large scale artificial production of fresh water from the sea, or brackish water, through the removal of salt.

DEQE - Massachusetts Department of Environmental Quality Engineering.

DIGESTION - The stabilization of sewage sludge by bacterial decomposition.

DISSOLVED SOLIDS - Organic an inorganic materials contained in water and wastewater.

DIVERSION - The transporting of water out of a watershed either as wastewater through the sewage system or as supply water taken through aqueducts to supply destinations. "Flood Skimming" is diversion which pipes flood waters out of streams and rivers, taking advantage of abundant spring flows.

DOMESTIC SEWAGE - Water that contains household wastes such as bathing water, human wastes and laundry wastes.

DO - Dissolved Oxygen - The oxygen freely available in water and necessary for aquatic life and the oxidation of organic materials; usually expressed in parts per million or percent of saturation.

DPH - Massachusetts Department of Public Health

DPU - Massachusetts Department of Public Utilities

DPW - Massachusetts Department of Public Works

ECOSYSTEM - The interacting system of a biological community and its non-living environment.

EFFECTIVE PRECIPITATION - Precipitation falling during the growing period of a crop that is available to meet the crop's consumptive water requirements.

EFFECTIVE RAINFALL - Rain that produces surface runoff.

EFFLUENT DISCHARGE - Discharge of pollutants into the environment (usually into the water).

EIR - Environmental Impact Report

EIS - Environmental Impact Statement

ENVIRONMENTAL CORRIDOR - A continuing stretch of productive lowlands on both sides of a stream, intended to conserve natural ecosystems, preserve natural valley flood storage, provide a buffer zone between river and development and aid in identifying a balance among compatible flood plain land uses.

EOEA - Massachusetts Executive Office of Environmental Affairs.

EPA - United States Environmental Protection Agency

ERDA - United States Energy Research and Development Administration.

ESTUARY - Aquatic area where fresh and salt water mix, such as the mouth of a river which flows to the sea.

EUTROPHICATION - An aging process in lakes, during which the water becomes overly rich in dissolved nutrients, resulting in excessive development of algae and other microscopic plants causing a decline in levels of dissolved oxygen (DO); with time, open water develops into bog, then marsh, and finally forest.

EVAPOTRANSPIRATION - Water withdrawn from soil by evaporation and from plants by transpiration. It is transmitted to the atmosphere as vapor.

FECAL COLIFORM BACTERIA - A family of bacteria found in fecal wastes used as an indicator of water quality; the recommended standards for drinking water are roughly equivalent to restricting the coliform concentration to not more than one organism per 100 milliliters of water.

FEDERAL WATER RESOURCES PLANNING ACT - PL 89-90 - Provides for optimum development of natural resources through the coordinated planning of water and water related land sources through the establishment of a water resources council and river basin commissions.

FEDERAL WATERSHED PROTECTION AND FLOOD PREVENTION ACT - PL 566 Assists local organizations, at their request, in the preparation of work plans for watersheds or sub-watershed regions of no larger than 250,000 acres for flood prevention.

FILTRATION - The mechanical removal of suspended solids by absorption or straining processes.

FLOOD FLOWS - High stream flow, overtopping the natural or artificial bank of a stream; usually occuring in the spring.

FLOOD PLAINS - The lowlands bordering a river, usually dry, but subject to flooding when the stream overflows its banks.

FLOOD PLAIN ZONING - Zoning to restrict development with adverse effects in inland or coastal flood-prone areas and coastal erosion areas.

FLOODWAY - The channel of a water course and non-structural modifications of properties and structures, intended to reduce or eliminate flood damage.

FRESHET FLOWS - The great rise in flows, or overflowing, of a stream caused by heavy rains or melted snow.

FWPCA - Federal Water Pollution Control Act of 1972 as amended PL 92 - 500; see sections 201 & 208.

GLACIAL DRIFT - Geologic deposits of silt, gravel and sand. The coarser the drift, the higher its permeability; these are the major water supply aquifers.

GPD - Gallons Per Day.

GROUND WATER - That part of total precipitation which seeps into soil and is held below the water table, in the zone of saturation; a large proportion of the total supply of fresh water.

GROUND WATER FLOW - The movement of water underground, usually referring to water flowing downgrad to a stream, lake or pond.

HABITAT - The sum total of the environmental conditions of a specific palce that is occupied by an organism, population or community.

HARDNESS - A measure of the quality of water. Water is considered "hard" if it contains significant quantities of dissolved minerals (e.g. calcium, iron, magnesium). Its most notable characteristic is its inability to lather soap.

HYDROGRAPHY - The study, description and mapping of oceans, lakes and rivers.

HYDROLOGIC CYCLE - The process in which water is transferred to the atmosphere through evaporation and evapotranspiration from the land, plants and water bodies. It falls again in the form of precipitation which either runs off the land into ponds streams or rivers, or is absorbed into the land which holds it below the water table.

HYDROLOGY - The science dealing with waters of the earth, their distribution on the surface and underground and the cycle involving evaporation, precipitation and flow into the seas.

HYGROSCOPIC - The moisture absorbed from the air.

INDUSTRIAL USER - Any firm that introduces its wastes, treated or untreated into public sewer systems or has wastes that are treated in a publicly owned treatment facility.

INFILTRATION - The flow of a fluid into a substance through pores or small openings. Often used to denote the inadvertant flow of ground water into sewers.

INFLUENT - The liquid that enters a treatment system.

INFRASTRUCTURE - The basic installations and facilities on which a community depends, such as roads; schools; transportation; power,sewer and water supply and distribution systems.

INTERSTICES - A small or narrow space or crevice between layers of soil or rock.

LAND APPLICATION - Method of wastewater treatment using soils, air, plants and bacteria to renovate wastewaters.

LEACHATE - Liquid that has moved through a porous medium.

LEACHING - Movement of liguid through porous materials and simultaneously carrying soluable material.

MAPC - Metropolitan Area Planning Council (Boston)

MBTA - Massachusetts Bay Transportation Authority

MDC - Metropolitan District Commission

MEAN ANNUAL RUNOFF - The average over a period of years of the annual amounts of runoff discharged by a stream.

MEPA - Massachusetts Environmental Policy Act, 1972

MGD - Millions of Gallons Per Day

MINIMUM FLOW - The flow occuring in a stream during the driest period of the year, also called low flow.

MINIMUM STREAM FLOW - The amount of water needed to support a particular function(s) in the stream, such as maintaining fish habitats.

MPN - MOST PROBABLE NUMBER - That number of organisms per unit volume that, in accordance with statistical theory, would be more likely than any other number to yield observed test results or that would yield the observed test result(s) with the greatest frequency.

MSD - Metropolitan Sewer District

MTA - Massachusetts Turnpike Authority

NATURAL VALLEY STORAGE - Land adjacent to a water course which stores water in times of flooding.

NAVIGABLE WATER - The waters of the United States, including the territorial seas, and intrastate waters.

NEPA - National Environmental Policy Act, 1969

NERBC - New England River Basins Commission

NERCOM - New England Regional Commission

NITRIFICATION - The oxidation of ammonia-nitrogen (NH_3-N) into nitrate-nitrogen (NO_3-N).

NONPOINT SOURCE POLLUTION - Any non-confirmed area from which pollutants enter waterways; i.e. urban runoff, agricultural runoff, landfills, and sedimentation from construction sites.

NONSTRUCTURAL FLOOD PLAIN MANAGEMENT - Flood plain management measures excepting structural flood control works - flood warning, preparedness, relocation, flood proofing, zoning, regulation, land acquisition, public investment policy, etc.

NRC - Nuclear Regulatory Commission

NUTRIENTS - A chemical substance (e.g. nitrogen or phosphorous) absorbed by green plants and used for growth.

OCS - Outer Continental Shelf

OUTFALL - The end of a sewer, drain or conduit from which an effluent is ultimately discharged.

OZONATION - A wastewater disinfection process using ozone.

PCB - Polychlorinated Biphenyl(s) - Toxic bi-products of plastics which are not bio-degradable or soluable.

PEAK DEMAND - The maximum momentary load placed on a water or wastewater plant or pumping station or on an electric generating plant or system. This is usually the maximum average load in one hour or less, but may be specified as instantaneous or with some other short time period.

PERCHED WATER TABLE - Created when precipitation encounters a subsurface layer of water, resistant rock or soil which prevents the water from reaching the water table.

PERMEABILITY - A measure of the capacity of a material to transmit water through its interstices or open spaces. The coefficient of permeability is the rate of flow of water in GPD through a cross section of one square foot under a unit of hydrologic gradient.

pH - A measure of the hydrogen ion concentration in a solution; water with a pH below 7 is considered acidic; over 7 is alkaline.

POINT SOURCE POLLUTION - Any conveyance such as a pipe, ditch or vessel from which pollutants are, or may be, discharged.

POLLUTION - The man-made or man-produced alterations of the chemical, physical, biological, and radiological integrity of water making it less desireable for the propogation of balanced indigenous populations of fish, for recreation, industry, wildlife or human uses.

POROCITY - A physical property of rocks and soil which measures openess; the amount of open space is stated as a percentage of the total volume (a porous substance can hold more water than a non-porous substance.).

PRECIPITATION - Rain, snow, mist, moisture which falls to the earth as part of the natural hydrologic cycle.

PRETREATMENT - Any process used to reduce pollutant loads before wastewater is introduced to a sewer system or delivered to a treatment facility.

PRIMARY TREATMENT - Mechanical wastewater treatment processes that remove floating or settleable solids by screening and sedimentation. Approximately 30% of the pollutants are removed through this process.

RAPID INFILTRATION - A land treatment method in which shallow treatment basins are periodically flooded with sewage effluent which receives additional renovation as the effluent percolates through the soil.

RAW SEWAGE - Untreated domestic or commercial wastewater.

RECEIVING WATERS - Water bodies into which sewage effluents are discharged.

RECHARGE - Replacement of groundwater by inflitration into the soil of rainwater, melting snow, runoff. The land area catching such rainfall, snowmelt, etc., is referred to as the recharge area.

RECLAMATION - The process of changing the condition or characteristic of land for its diverse utilization; also applied to water.

RIPARIANS - Water users living or located on the bank on the bank of a natural water course such as a river.

RIPARIAN RIGHTS - The rights of a land owner to the reasonable use of the water on or bordering his property, including the right to receive water relatively undiminished in quantity and quality from upstream sources.

RIVER BASIN - A series of watersheds drained by a river and its tributaries; there are 267 major and minor basin areas in the United States.

RUNOFF - The portion of rainfall, snow or irrigation water that flows across the ground surface.

SAFE DRINKING WATER ACT- PL 93 - 523 - A federal law requiring any public or privately owned water system serving more than 25 people to meet minimum water supplies through daily and monthly measurements.

SAFE YIELD - The dependable yield of a water system and/or any of its elements such as a well, reservoir, aqueduct or pumping station. It is generally the capacity that must be used for long range planning but usually allows for emergencies, droughts, equipment breakdowns and may be exceeded for a short period of time.

SALINITY - Pertains to the concentration of salts in water.

SALT WATER INTRUSION - The movement of salt into a body of fresh water. Pumping wells in a coastal area at a rate which exceeds fresh water recharge will result in salt water intrusion.

SANITARY SEWER - A sewer that collects only domestic or commercial wastewater.

SATURATED ZONE - The zone of the earth's surface which is saturated with water and contains ground water supplies. Its uppermost limit is called the "water table".

SCREENING - The removal of relatively coarse floating suspended solids by straining through racks and screens,

SECONDARY TREATMENT - Biological treatment process in which bacteria consume organic wastes. Approximately 85% of the pollutants are removed in this process.

SECTION 201 - FWPCA - Section 201 provides grants for the construction of treatment works, including innovative and alternative processes & techniques for reclaiming & reuse of water (emphasized in 1977 amendments).

SECTION 208 - FWPCA - Section 208 plans are prepared by the State's Regional Planning Agencies and deal with land use, facility planning, on-lot waste disposal systems, industrial wastes, residuals, urban runoff, nonpoint source and other waste pollution sources.

SEDIMENTATION - Settling of solids from solution.

SEPTIC TANK - An underground tank used for the treatment of domestic wastes.

SETTABLE SOLIDS - The matter in wastewater heavy enough to settle out of solution.

SEWAGE - The contents of a sewer or drain; refuse liquids or waste matter carried by drains; generated by residences, commercial establishments and industrial plants.

SEWER - Any pipe or conduit used to collect and carry away sewage or storm water runoff from the generating source to treatment plants or receiving streams.

SEWERAGE - The systematic removal and disposal of sewage and general surface water by sewers; the system of sewers and storm drains in cities and towns.

SILTATION - The filling or choking of an area with fine grained, unconsolidated sediment by the movement of water.

SLUDGE - The solids generated or removed during the wastewater processes.

SORTING - A measure of the range of particle sizes from very small (clay, silt) to very large (pebbles, cobbles). The degree of sorting of grain sizes is an important determinant of the water - holding and water-transmitting characteristics of a soil sample.

SPECIFIC YIELD - The volume of water that will drain from a sample by gravity, stated as a percentage of the gross volume of the sample.

SPRAY IRRIGATION - A land treatment method in which wastewater effluent is renovated by percolation through soil and by plant intake.

STANDARD PROJECT FLOOD - The flood hydrograph representing runoff from the standard project storm adopted by the Corps of Engineers as the basis for structural and operational design of a flood control project.

STREAMFLOW - The amount of water in a brook, stream or river, measured as a volume passing a particular point over a unit of time. (usually cubic feet per second; cfs)

STRUCTURAL FLOOD PLAIN MANAGEMENT - Measures designed to modify floods including dams, flood control reservoirs, dikes, levees, flood walls, channel modifications and land treatment.

SURFACE WATER - The supply of fresh water on the earth's surface such as rivers, lakes, streams and oceans.

SUSPENDED SOLIDS (SS) - Wastewater solids which do not settle from solution upon standing; SS, along with BOD, is used as a measure of water quality and an indication of treatment plant efficiency.

TERTIARY TREATMENT - Advanced wastewater treatment which removes approximately 90 - 95% of the pollutants.

THERMAL POLLUTION - The impairment of water quality through temperature increase, usually from discharges of industrial cooling water.

THERMOELECTRIC POWER - Power produced by steamplants. Nearly all of the water used by thermoelectric power plants is used for condensing steam. In 1975, thermoelectric power generation constituted 80% of industrial water use.

TOXIC POLLUTANT - An element, molecule or compound that causes death, disease, genetic or physical deformation in any organism or their offspring.

TRANSMISSIBILITY - A measure of the capacity of a material to transmit water. The coefficient of transmissibility is the rate of flow of water in GPD through its vertical strip of the aquifer, one foot wide having a height equal to the thickness of the aquifer and under a unit of hydrologic gradient.

TRICKLING FILTER - A bed of crushed rock that supports the bacterial growth used to renovate applied wastewater; a secondary treatment process.

TURBIDITY - A muddy or cloudy condition in water due to the presence of fine suspended matter, either organic or inorganic.

VENDIBLE OUTPUTS - Those benefits from water supply, irrigation, power and recreation projects for which the federal government receives revenues from project beneficiaries under present policies, as opposed to Nonvendible outputs which are not a source of revenues. Water supply and hydroelectric power are vendible outputs, flood control is a nonvendible output.

WASTE ASSIMILATION - The capacity of a stream or water body to absorb waste discharge without significant degradation of the quality of the water.

WASTEWATER - The spent water of a community, that which is discharged into the sewers.

WATER CONSUMPTION - That portion of a withdrawal which is not returned as recharge to the groundwater system; water which evaporates or is discharged to the sea is consumed.

WATERCOURSE - A channel through which water flows such as a river, stream or brook.

WATERCOURSE AQUIFER - Aquifers adjacent to streams or rivers which are primarily recharged by the watercourse and whose sustained yield is associated with the low flow of the watercourse.

WATER QUALITY CRITERIA - The levels of pollutants that affect the suitability of water for a given use.

WATER QUALITY STANDARD - A plan for water quality management specifying: the use (recreation, fish and wildlife propogation, drinking supply, industrial or agricultural) to be made of the water; criteria to measure and protect these uses; implementation and enforcement plans; and an anti-degradation statement to protect existing water quality.

WATERSHED - An area of land drained by a given stream.

WATER TABLE - The upper level of ground water.

WETLANDS - Lands where the water table is near or at the surface most of the year; aquatic vegetation such as cattails is typical; marshes and swamps are typical wetlands.

WRC - WATER RESOURCES COMMISSION, Commonwealth of Massachusetts

WRC - UNITED STATES WATER RESOURCES COUNCIL - Federal Agency, President's policy advisors and enforcement arm for water related issues.

ZONE OF AERATION - The zone of the earth's surface which filters, but does not retain, water as it seeps through to the saturated zone.

ZONE OF SATURATION - The zone of the earth's surface which retains water and contains ground water supplies. Its uppermost limit is called the "water table"; also referred to as the aquifer.

APPENDICES A-O

LEGISLATION PROPOSED BY THE COMMISSION

I. Relating to Improved Management of the Metropolitan Water District

Demand Management

A. An Act Further Regulating the Provision of Water by the Metropolitan District Commission

B. An Act Providing for the Designation of an Office of Water Conservation Within the Metropolitan District Commission

Supply Management

C. An Act Concerning Abandonment of Water Supplies in the Metropolitan Water District

D. An Act Permitting Metropolitan Water District Member Communities to Develop Additional Supplies to Augument the Water They Receive From the Metropolitan Water District

II. Providing Technical and Financial Assistance to Communities to Insure Continued Adequacy of Water Supplies

Demand Management

E. An Act Establishing a State Office of Water Conservation

F. An Act Providing Financial Assistance to Cities, Towns and Water Districts for the Repair and Rehabilitation of Their Water Distribution Systems

Supply Management

G. An Act Providing Increased Funding by the Commonwealth for the United States Geological Survey Cooperative Survey Program for Groundwater Assessments and Related Hydrological Studies

H. An Act Expanding Time Limits for which Communities May Borrow Outside Their Debt Limit for Purposes of Providing Water to Their Inhabitants

III. Improving State Regulations and Management Capabilities Relative to Water Supplies

Demand Management

I. An Act Requiring Water Conserving Plumbing Fixtures in Certain Buildings in the Commonwealth

Supply Management

J. An Act Further Defining the Supervision of the Waters of the Commonwealth to Include Regulation of Materials Hazardous to Water Supplies

K. An Act Further Defining the Duties and Responsibilities of the Division of Water Pollution Control to Include Groundwater Contamination

Administrative Management

L. An Act Further Defining the Powers and Duties of the Water Resources Commission to Include Drought Contingency Planning

M. An Act Concerning Local Water Resource Management Plans for State Funding of Water Projects

N. An Act Establishing a Division of Water Resources Planning and Technical Assistance

IV. Continuing Resolve

O. Resolve Reviving, Continuing and Increasing the Scope of the Special Commission Established to Make an Investigation and Study Relative to the Adequacy of Water Supply in the Commonwealth

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX A.

AN ACT

FURTHER REGULATING THE PROVISION OF WATER BY THE METROPOLITAN DISTRICT COMMISSION.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 10 of Chapter 92 of the General Laws is hereby amended by striking out the first paragraph and inserting in place thereof the following new paragraph:

(1) The commission shall construct, maintain and operate a system of metropolitan water works and shall provide thereby a sufficient supply of pure water for the following named towns and the inhabitants thereof: Arlington, Belmont, Boston, Brookline, Chelsea, Everett, Lexington, Malden, Medford, Melrose, Milton, Nahant, Newton, Quincy, Revere, Somerville, Stoneham, Swampscott, Watertown and Winthrop, which shall be members of, and shall constitute, the metropolitan water district; shall secure and protect the purity of said water; shall on application furnish water to any town aforesaid that at the time of application owns its water pipe system; shall on application admit to membership in said

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water district any other town any part of which is within ten miles of the state house which the commission can reasonably supply with water, and any other town any part of which is within fifteen miles of the state house which the commission can reasonably supply with water, provided that no new members shall be admitted unless average yearly consumption of commission water is below the calculated safe yield of the system, and shall furnish water to such town on the terms prescribed by this chapter for the towns constituting said district upon payment of an entrance fee in the amount prescribed by this section; and shall, upon application, furnish water to any water company owning the water pipe system in any member town, upon the assumption in writing by such water company of the assessments, if any, of the town, and upon the making by such water company of such payment as the commission may determine. The commission shall furnish water to the member town or to such company, by delivering it into a main pipe, reservoir or tank of the town or company, under sufficient pressure for use without local pumping, unless delivered in some other manner by mutual agreement between the parties interested; and shall have the direction and control of the connections between the metropolitan and local systems. Each such town admitted to membership after January first, nineteen hundred and forty-five, and provided with a connection with the works of the metropolitan water district shall be assessed and pay, as prescribed by section twenty-six, its fair share of the cost of connection as determined by the commission and certified to the state treasurer, which may, if and as determined by the

commission, be distributed over a period not exceeding ten years.

SECTION 2. Said section of said chapter is hereby further amended by striking out paragraph (3) and inserting in place thereof the following new paragraph:

(3) The commission, subject to all the provisions relating to the construction, operation and maintenance by it of a water supply system set forth in this chapter, may sell and deliver water from any of the reservoirs or aqueducts of the metropolitan water system, provided that average yearly consumption of commission water is below the calculated safe yield of the system, to any institution, agency or facility established in the commonwealth by the United States or by any agency or instrumentality of the United States, or to any agency or instrumentality of the commonwealth or of any county thereof, and lay and maintain pipe lines and other works necessary therefor, upon terms and conditions to be agreed upon by the duly authorized officer or representative of the United States government, or of the commonwealth or of any county thereof, as the case may be, and the commission; and may sell and deliver water from any of the reservoirs or aqueducts of the metropolitan water system, provided that the average yearly consumption of commission water is below the calculated safe yield of the system, to any town or group of towns not eligible to membership because of location wholly more than fifteen miles from the state house, or because otherwise not within reasonable reach of the distribution system as provided as provided in paragraph (1) of this section, to any water company, or to any water, fire or

fire and water district, authority to purchase the same being hereby granted, and may lay and maintain pipe lines and other works necessary therefor upon terms and conditions to be mutually agreed upon by the commission and said town or group of towns, water company or district.

SECTION 3. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX B.

AN ACT

PROVIDING FOR THE DESIGNATION OF AN OFFICE OF WATER CONSERVATION WITHIN THE METROPOLITAN DISTRICT COMMISSION

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 92 of the General Laws is hereby amended by inserting after section 15 the following new section:-

Section 15A. There shall be designated within the commission an office of water conservation, which shall be headed by a director, to be appointed by the commissioner of the Metropolitan District Commission and who shall not be subject to the provisions of Chapter 31. Said office is authorized to employ appropriate staff and consultants to develop policies and programs to further water conservation efforts within the metropolitan water district. The office shall prepare annually a report of the year's conservation program, including but not limited to an evaluation of the program's impact in terms of progress towards stated goals and an outline of plans for the forthcoming year. Said report shall be submitted to the governor of the commonwealth, the president of the senate, the speaker of the house, the secretary of environ-

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mental affairs and the water resources commission, and shall be made available to the general public upon request.

Section 2. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX C.

AN ACT

CONCERNING ABANDONMENT OF WATER SUPPLIES IN THE METROPOLITAN WATER DISTRICT

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 92 of the General Laws is hereby amended by striking out paragraph (7) of section 10 and inserting in place thereof the following new paragraph:

(7) No town which is a member of the metropolitan water district or which is applying for membership in the metropolitan water district shall abandon any local water supply source in use as of January first nineteen hundred seventy nine and take its entire supply from said district unless such local water supply source is declared unfit by the department of environmental quality engineering and cannot be restored.

Section 2. Said chapter is hereby further amended by striking out paragraphs (8), (10) and (11).

Section 3. The Metropolitan District Commission shall investigate or cause to be investigated all past abandoned or unused supplies

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of water for the purpose of determining their suitability as an alternative source of water supply to the water district. If during the course of said investigation, any such abandoned or unused supply proves inadequate for drinking water supply purposes, said abandoned or unused supply shall be further investigated and evaluated as an alternative supply for purposes other than for drinking. The results of said investigation shall be transmitted to the governor of the commonwealth, the president of the senate, the speaker of the house, the secretary of environmental affairs and the water resources commission and shall be made available to the public upon request, one year from the date of passage.

Section 4. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX D.

AN ACT

PERMITTING METROPOLITAN WATER DISTRICT MEMBER COMMUNITIES TO DEVELOP ADDITIONAL SUPPLIES TO AUGMENT THE WATER THEY RECEIVE FROM THE METROPOLITAN WATER DISTRICT.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 23 of Chapter 488 of the Acts of 1895 is hereby amended by striking said section and declaring that the provisions of said section are null and void.

Section 2. Section 16 of Chapter 92 of the General Laws is hereby amended by striking the first sentence thereof and inserting in place thereof the following new sentence:-

Any town, any part of which is within ten (10) miles of the state house, or water company owning a water pipe system in any such town may develop and use for domestic purposes, water from any source not now used by it.

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The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX E.

AN ACT

ESTABLISHING A STATE OFFICE OF WATER CONSERVATION.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 21 of the general laws is hereby amended by inserting after section 11 the following new section 11A:

Section 11A. There shall be designated under the jurisdiction of the commission a state office of water conservation, which shall be headed by a director, to be appointed by the commission, who shall not be subject to the provisions of chapter 31. Said office is authorized to employ appropriate staff and consultants to develop policies and programs to further water conservation within the commonwealth, including but not limited to the provision of legal and technical assistance to local water utilities, conservation commissions and municipal agencies for the implementation of local water conservation programs, development of educational curricula and materials, investigation of the effects of various pricing

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policies, recommendations for regulatory changes in other state agencies, and recommendations for legislative changes to further water conservation. Said office may receive grants from federal, regional or other governmental or private sources for such purposes.

SECTION 2. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX F.

AN ACT

PROVIDING FINANCIAL ASSISTANCE TO CITIES, TOWNS AND WATER DISTRICTS FOR THE REPAIR AND REHABILITATION OF THEIR WATER DISTRIBUTION SYSTEMS.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The cities, towns and water districts of the commonwealth are hereby authorized to expend such funds from the amounts specifically appropriated therefor by the legislature on a fifty percent matching basis specifically for the purpose of investigating and identifying sources of loss of potable water and for rehabilitating their water supply distribution systems including cleaning and relining of mains, laterals and associated distribution elements or replacement of said mains, laterals and associated elements.

SECTION 2. The division of water supply shall be responsible for the administration of this program and shall establish standards and guidelines for the operation of said program. Criteria and priorities for the receipt of such funds as may be made available by the general court or by federal or other

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governmental agencies shall be established by the water resources commission and shall include but not be limited to the amount of unaccounted for water usage in a community, the institution of an on-going leak detection program, repair of leaks identified by community or water district leak detection program, repair of distribution systems to provide adequate pressure for fire protection, and the repair of distribution systems to maintain public health standards. In addition, any city, town or water district receiving such assistance shall have adopted or be in the process of adopting a comprehensive water resources management plan pursuant to regulations established by the water resources commission.

Five percent of the funds specifically appropriated for such assistance by the general court shall be designated for leak detection program assistance and the remainder of said funds shall be designated for system rehabilitation assistance. No city, town or water district shall be eligible for more than five percent of the total amount designated for leak detection assistance and five percent of the total amount designated for system rehabilitation assistance.

SECTION 3. Upon receipt by any city, town or water district of federal funds granted expressly for the purpose of leak detection or rehabilitation of distribution systems, including replacement or cleaning and relining, such city, town or water district receiving assistance under this act shall reimburse the commonwealth for such assistance in the amount that the federal funds granted exceed forty percent of said programs.

SECTION 4. The state treasurer may borrow from time to time on the credit of the commonwealth such sums of money as may be necessary for the purpose of meeting payments as authorized by this act, and may issue and renew from time to time notes of the commonwealth therefor, bearing interest payable at such times and rates as shall be fixed by the state treasurer, for a period of time not exceeding five years. The issuance of said notes shall be in compliance with Article LXII, section 3 of the Amendments to the Constitution of the Commonwealth.

SECTION 5. To meet the expenditure necessary in carrying out the provisions of this act, the state treasurer shall, upon the request of the governor, issue and sell at private or public sale bonds of the commonwealth registered or with interest coupons attached, as he may deem best, to an amount specified by the governor from time to time, but not exceeding in the aggregate, the sum of ten million dollars. All bonds issued by the commonwealth for the purposes of this act shall bear on their face the words "Water Supply System Rehabilitation Act of 1979" and shall be on a serial payment plan for such maximum term of years, not exceeding thirty years, as the governor may recommend to the general court pursuant to Article LXII, section 3 of the Amendments to the Constitution of the Commonwealth.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX G.

AN ACT

PROVIDING INCREASED FUNDING BY THE COMMONWEALTH FOR THE UNITED STATES GEOLOGICAL SURVEY COOPERATIVE SURVEY PROGRAM FOR GROUNDWATER ASSESSMENTS AND RELATED HYDROLOGICAL STUDIES.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Declaration of Policy; Short Title

(a) It is hereby declared that for the benefit of the people of the commonwealth, the increase of commerce, welfare and prosperity of the state and its residents, and the necessity of providing a continued water supply, that it is necessary for the commonwealth to participate with continued funding for the state's contribution to the cooperative survey program of the United States Geological Survey (USGS).

(b) This act may be referred to as the "Groundwater Survey Act of 1979."

SECTION 2. Section 8 of chapter 21 of the general laws as most recently amended by chapter 291 of the Acts of 1977, is hereby further amended by inserting after said section the following new section 8A:

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Section 8A. (a) The commission shall be the coordinating body for the purposes of administration of this program. The commission shall contract or cause to be contracted with the USGS to conduct a ten year program of detailed groundwater appraisals, aquifer assessments, and such other appropriate geologic and hydrologic studies as may be required for the protection of existing sources of groundwater supply and for the identification of new groundwater sources.

(b) Said groundwater survey program shall include aquifer identification and assessments of quality and yield, and direct technical assistance to localities to solve groundwater problems of less than regional scale; assistance to localities shall be based on criteria and priorities to be established by the commission which shall include, but not be limited to, the following: a present or recurrent water supply deficit; areas in which the survey would serve more than one community; communities which have suffered loss of supply due to contamination; communities in which demands are placed on supply systems by state institutions; and local commitment to participation. Direct local assistance shall not exceed five hundred thousand dollars and shall be funded fifty percent by USGS and fifty percent by the commonwealth.

(c) For the purposes of this act, groundwater is defined as that portion of the earth's water which is below the surface of the earth.

SECTION 3. (a) Said program shall not exceed in the

aggregate the sum of five million dollars, fifty percent to be funded by the USGS and fifty percent to be funded by the commonwealth.

(b) The state treasurer may borrow from time to time on the credit of the commonwealth such sums of money not to exceed in the aggregate two million five hundred thousand dollars as may be necessary for the purposes of meeting payments as authorized by this act, and may issue and renew from time to time notes of the commonwealth therefor, bearing interest payable at such times and rates as shall be fixed by the state treasurer in compliance with Article LXII, section 3 of the Amendments to the Constitution of the Commonwealth.

SECTION 4. To meet the expenditures necessary in carrying out the provisions of this act, the state treasurer shall upon the request of the governor, issue and sell at public or private sale, bonds of the commonwealth registered or with interest coupons attached, as he may deem best, to an amount specified by the governor from time to time but not exceeding in the aggregate the sum of two million five hundred thousand dollars. All bonds issue by the commonwealth, as aforesaid, shall be designated on their face, Groundwater Survey Act of 1979, and shall be on the serial payment plan for such maximum term of years, not exceeding ten years, as the governor may recommend to the general court pursuant to section 3, Article LXII of the Amendments to the Constitution of the Commonwealth, the maturities thereof to be so arranged that the amounts payable in the several years of the period of amortization other than

the final year shall be as nearly equal as in the opinion of the state treasurer it is practical to make them. Said bonds shall bear interest semi-annually at such rate as the state treasurer, with the approval of the governor, shall fix. The initial maturities of such bonds shall be payable not later than one year from the date of issue thereof and the entire issue not later than June the thirtieth, nineteen hundred and ninety.

SECTION 5. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX H.

AN ACT

EXPANDING TIME LIMITS FOR WHICH COMMUNITIES MAY BORROW OUTSIDE THEIR DEBT LIMIT FOR PURPOSES OF PROVIDING WATER TO THEIR INHABITANTS

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 8 of Chapter 44 of the General Laws is hereby amended by striking clause (3) as inserted by Chapter 172 of the Acts of 1938 and inserting in place thereof the following new clause:-

(3) For establishing or purchasing a system for supplying a city, town or water and fire district and its inhabitants with water, for taking or purchasing water sources either from public land or private suppliers, or water or flowage rights, for the purpose of public water supply, or for taking or purchasing land for the protection of a water system, forty years.

Section 2. Said section of said chapter is further amended by striking at the end of clause (5) the words "fifteen years" and inserting in place thereof the words "twenty-five years."

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The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX I.

AN ACT REQUIRING WATER CONSERVING PLUMBING FIXTURES IN CERTAIN BUILDINGS IN THE COMMONWEALTH

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 142 of the General Laws is hereby amended by inserting after section 13 the following new section 13A:

SECTION 13A. The examiners, subject to the approval of the department of environmental quality engineering, shall require that all buildings, public and private, be fitted with plumbing fixtures which comply with the following standards of water use: (1) tank type water closets - maximum 3 gallons (11.4 liters) per flush; (2) flushometer water closets - maximum 3 gallons (11.4 liters) per flush; (3) flushometer urinals - maximum 1.5 gallons (5.7 liters) per flush. The provisions of this section shall apply to all new construction as well as to renovation and replacement in existing structures after the effective date of this act. In satisfaction of the requirements of this section, the examiners shall permit the installation of tank-type

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water closets equipped with devices which are found by the examiners to meet applicable standards, in water closets having a tank capacity in excess of 3 gallons (11.4 liters). The examiners may also allow the use of standard flush water closets and urinals which do not neet the specified standards when in the opinion of the examiners the configuration of the building drainage system requires a greater quantity of water to adequately flush the system. The examiners shall publish or cause to be published periodically a list of acceptable fixtures and devices which comply with applicable standrads.

SECTION 2. This act shall take effect July 1, 1978.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX J.

AN ACT

FURTHER DEFINING THE SUPERVISION OF THE WATERS OF THE COMMONWEALTH BY THE DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING TO INCLUDE MATERIALS POTENTIALLY HAZARDOUS TO WATER SUPPLIES

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 159 of Chapter 111 of the General Laws as most recently amended by Section 184 of Chapter 706 of the Acts of 1975 is hereby further amended by inserting after the second sentence, the following new sentences.

It shall further establish regulations for the monitoring and control of all substances which are potentially hazardous to said waters, including but not limited to the use and storage of such substances, to protect such waters and shall periodically review and update said regulations. The list of said substances shall include, but not be limited to, the substances specified as hazardous by the federal government as updated periodically.

The remainder of the section remains unchanged.

Section 2. This act shall take effect uppon its passage.

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The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY- NINE

APPENDIX K.

AN ACT

FURTHER DEFINING THE DUTIES AND RESPONSIBILITIES OF THE DIVISON OF WATER POLLUTION CONTROL TO INCLUDE GROUND-WATER CONTAMINATION

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 27 of Chapter 21 of the General Laws as most recently amended by section 3 of Chapter 546 of the Acts of 1973 is hereby further amended by adding the term "underground waters" to paragraph (4) so as to read:

(4) Conduct a program of study and research and demonstration, by itself or in cooperation with other governmental agencies, relating to new and improved methods of pollution abatement, or more efficient methods of water quality control, including treatment, neutralization and stabilization of sewage and industrial waste and disposal thereof by treatment or disposal plant, sewer systems, pumping stations or acceleration flow or other methods, facilities or equipment so as to insure cleaner waters in the coastal waters, rivers, streams, lakes, ponds and underground waters of the commonwealth.

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Section 2. Said section of said chapter is hereby further amended by adding the term underground waters to paragraph (8) so as to read:

(8) Examine periodically the water quality of the various coastal waters, streams. lakes, ponds and underground waters of the commonwealth, or separate portions of such waters, and publish the results of such examinations together with the standard of water quality established for the various waters or portions thereof.

Section 3. Said section of said chapter is hereby further amended by adding the term petroleum to the third sentence of paragraph (14); said sentence shall therefor read as follows:

In this clause, the word "oil" shall mean insoluble or partially soluble oils of any kind or origin or in any form including, but not limited to, petroleum, crude or fuel oils, lube oil or sludge, asphalt, insoluble of partially soluble derivatives of mineral, animal or vegetable oils.

. . . . The sentences and sub-paragraphs remaining in paragraph (14) shall remain as inserted by Chapter 546 of the Acts of 1973.

Section 4. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX L.

AN ACT

FURTHER DEFINING THE POWERS AND DUTIES OF THE WATER RESOURCES COMMISSION TO INCLUDE DROUGHT CONTINGENCY PLANNING

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Section 9 of Chapter 21 of the General Laws as most recently amended by Section 61 of Chapter 706 of the Acts of 1975 is hereby further amended by insering at the end of the second, third and fourth sentences the words "drought contingency planning" so as to read as follows:

Section 9. The commissioner of environmental management and the commissioner of environmental quality engineering shall be co-chairmen of the commission. The commission shall meet on matters conserning watersheds, water systems, storage basins, both natural and artificial, underground and surface water supplies, and shall study the needs, supplies and resources of the commonwealth with respect to water conservation, flood prevention and drought contingency planning. The commission shall hold hearings for these purposes at times and places convenient to the public and shall from time to time make recommendations for legislation designed

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to provide the commonwealth with a basic water policy based upon the common and interdependent interests of agriculture, industry, recreation, wildlife, conservation, domestic consumption, flood prevention and drought contingency planning in a systematic manner. It shall act as a coordinating agency between all departments of the commonwealth and shall cooperate with the agencies of the federal government and all other states in carrying out water conservation, flood prevention and drought contingency planning. It shall be the agency of the commonwealth having supervisory responsibility over programs provided for by the Watershed Protection and Flood Prevention Act (Public Law 566-83d Congress, 2nd session), and shall carry out, maintain and operate any works of improvement authorized by said federal act and as limited by section 14; provided, that it shall not be an applicant for assistance under said federal act.

Section 2. The second through fourth paragraphs of said section of said chapter shall remain unchanged.

Section 3. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX M.

AN ACT

CONCERNING LOCAL WATER RESOURCE MANAGEMENT PLANS FOR STATE FUNDING OF WATER PROJECTS

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 21 of the General Laws is hereby maended by inserting after section 11 the following new section:-

Section 11B. Any town or city in the commonwealth otherwise eligible to receive state assistance for any project involving water or sewer works, development of water supplies, flood control projects or any other water related program administered under the executive office of environmental affairs shall, as a further condition of eligibility, have adopted or be in the process of adopting a comprehensive water resource management plan pursuant to regulations established by the water resources commission. It shall be the responsibility of the water rescurces commission to certify to the appropriate funding agency or division that a town or city has adopted or is in the process of adopting such a plan. Technical assistance to a town or city for the preparation of such

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a plan by any state agency shall be exempt from this requirement.

Section 2. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX N.

AN ACT

ESTABLISHING A DIVISION OF WATER RESOURCES PLANNING AND TECHNICAL ASSISTANCE

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. Chapter 21 of the General Laws is hereby amended by inserting after Section 8 the following new section:-

8B. There shall be established under the commission a division of water resources planning and technical assistance, which shall be headed by a director, appointed by the commission, who shall not be subject to the provisions of Chapter 31. Said division may employ appropriate staff and consultants to carry out the provisions of this section. The responsibilities and duties of said division shall include: comprehensive basin and statewide water resources planning; the direction and coordination of all cooperative water and related land resources data programs between the state and federal and regional agencies; the provision of integrated technical assistance to communities and regions for water and other resource management needs; direction of a lakes management

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program for the commonwealth; water conservation research and technical assistance; and the provision of water resource data and expertise to other state agencies and divsions.

Section 2. This act shall take effect upon its passage.

The Commonwealth of Massachusetts

IN THE YEAR ONE THOUSAND NINE HUNDRED AND SEVENTY-NINE

APPENDIX O.

RESOLVE REVIVING, CONTINUING AND INCREASING THE SCOPE OF THE SPECIAL COMMISSION ESTABLISHED TO MAKE AN INVESTIGATION AND STUDY RELATIVE TO THE ADEQUACY OF WATER SUPPLY IN THE COMMONWEALTH.

Resolved, That the special commission, created according to chapter thirteen of the resolves of nineteen hundred and seventy-seven, be revived and continued, and that the scope of study of said commission be specifically broadened to include the investigation of all allocations of water rights in the commonwealth, both surface and subsurface, which have been made by special acts of the general court, and further that said commission shall recommend to the general court a mechanism or mechanisms for reviewing and evaluating all unexercised rights and all future allocations, surface and subsurface, for consistency with sound basin water resource management practices to insure continued and future adequacy of water supplies in the commonwealth; and further that said commission shall investigate, study and make recommendations to the general court for the redefinition of groundwater law in the commonwealth necessary to accomplish the aforesaid.

Said commission may travel within and without the commonwealth, and shall report to the general court not later than the fourth wednesday of december, nineteen hundred seventy-nine.

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